

VARIATION IN EURASIAN SHREWS OF THE GENUS *CROCIDURA* (INSECTIVORA:SORICIDAE)

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SYNOPSIS

An investigation including the use of a canonical variate analysis is made into the relationships between various species of *Crocidura* occurring in Eurasia. The status of species and their geographical variation are examined and keys are provided to aid segregation of species.

C. suaveolens is the most widespread species. *C. zarudnyi* is regarded as a distinct species showing some affinity to *C. suaveolens* and to Asian *C. russula*. *C. russula* is divisible into two main groups – Europe/Algeria and western Asia. The latter group is close to some populations of *C. suaveolens*. The European/Algerian group shows some association with western Asian *C. leucodon*. The Japanese form, *C. dsinezumi*, while somewhat similar to some populations of *C. suaveolens* and Asian *C. russula*, is sufficiently distinct to retain specific status. *C. leucodon* is also divided into European and western Asian groups and the Iranian *casgica* is considered to be a subspecies of the latter group. The affinities of the western Asian group of *C. leucodon* and *C. lasiura* are discussed. *C. fuliginosa trichura* is assigned to *C. attenuata*. *C. dracula* is allocated to *C. fuliginosa* and some of the forms recorded from Indonesia are considered to belong to this species. *C. horsfieldi* is compared with *C. suaveolens* but retained as a distinct species. Short notes are made on other species occurring in the area.

INTRODUCTION

WHITE-TOOTHED shrews of the genus *Crocidura* occur mainly southwards from latitude 53°N in the Palaearctic, Oriental and Ethiopian regions. This report is concerned with those species from the first two regions.

Ellerman & Morrison-Scott (1966) recognized only fourteen species amongst the forty four species names recorded from the Palaearctic and Indian regions. Chasen (1940) listed twenty nine species names from the Malaysian subregion of the Oriental region. It is possible that the same species occur under different names in different areas, so comparison over the entire area was considered necessary.

New forms have frequently been described from single specimens but only rarely figured and with inadequate descriptions. Information on colour of pelage, external dimensions and a few skull measurements does not seem to provide adequate diagnoses; while diagnostic characters that vary from species to species, yet are intraspecifically constant, are distinctly lacking in this genus.

This report describes geographical variation between populations occurring throughout Eurasia. A canonical variate analysis has been used to investigate relationships between populations. This type of analysis allows metrical characters of a large number of samples to be handled simultaneously but is limited to those specimens possessing all the necessary characters. The results have been correlated with all other available information and some changes to the existing taxonomy are suggested.

MATERIALS

The collections of the British Museum (Natural History) (BMNH) contain 740 specimens from Eurasia. All of these were examined and, for the sake of completeness, specimens of North African *C. russula* and *C. suaveolens* (which are mainly distributed in Europe and Asia) were included. In addition the following specimens from other institutions have been examined: Harrison Zoological Museum, Sevenoaks: *C. russula* - 28; *C. russula caspica* - 3, *C. leucodon judaica* - 2, *C. lasia* - 1; United States National Museum: *C. zarudnyi* - 9, *C. pergrisea* - 2; Naturhistorisches Museum, Vienna: *C. pergrisea arispa* - 1.

C. olivieri, *C. religiosa* and *C. floweri* from Egypt have been excluded because they are confined to Africa and are readily distinguished from Eurasian species. Since the BMNH collections do not contain any of the eight species listed by Taylor (1934) from the Philippine Islands these have also been excluded.

For the canonical variate analysis (CVA) the number of available specimens was reduced to 526, since the method demanded specimens complete for all of the characters included. In the CVA the group of specimens from each locality is referred to by the term operational taxonomic unit (OTU) followed by the number of the group (see Table 1 and Fig. 1).

TABLE 1

Populations entered in the canonical variate analysis

OTU	Locality	No. of specimens	Current species name
1	Isles of Scilly	10	<i>C. suaveolens cassiteridum</i>
2	Jersey and Sark	9	<i>C. suaveolens</i>
3	Guernsey and Alderney	15	<i>C. russula petra</i>

TABLE I (Cont.)

OTU	Locality	No. of Specimens	Current species name
4	France	11	<i>C. russula russula</i>
5	France	14	<i>C. leucodon leucodon</i>
6	Spain	7	<i>C. russula pulchra</i>
7	Portugal	8	<i>C. russula pulchra</i>
8	Algeria	16	<i>C. russula agilis</i>
9	Algeria	4	<i>C. suaveolens whitakeri</i>
10	Germany, Belgium and Holland	17	<i>C. russula russula</i>
11	Germany	9	<i>C. leucodon leucodon</i>
12	Switzerland	8	<i>C. suaveolens mimula</i>
13	Switzerland	19	<i>C. russula russula</i>
14	Switzerland	8	<i>C. leucodon leucodon</i>
15	Sicily	5	<i>C. sicula</i>
16	Sardinia	9	<i>C. russula ichnusae</i>
17	Corsica	11	<i>C. russula cyrenensis</i>
18	Rumania and Hungary	5	<i>C. suaveolens mimula</i>
19	Yugoslavia	15	<i>C. suaveolens mimula</i>
20	Yugoslavia	21	<i>C. leucodon</i>
21	Greece	8	<i>C. suaveolens mimula</i>
22	Turkey	11	<i>C. russula monacha</i>
23	Turkey	15	<i>C. leucodon lasia</i>
24	Lebanon	11	<i>C. russula</i>
25	Israel	16	<i>C. russula</i>
26	Lebanon and Israel	7	<i>C. leucodon judaica</i>
27	Iran	7	<i>C. russula caspica</i>
28	Afghanistan	5	unnamed
29	Pakistan	8	<i>C. zarudnyi</i>
30	Russian Turkestan	18	<i>C. suaveolens ilensis</i>
31	Kashmir	6	<i>C. russula pullata</i>
32	Punjab	11	unnamed
33	Sri Lanka	14	<i>C. horsfieldi</i>
34	Darjeeling	14	<i>C. attenuata rubricosa</i>
35	Bhutan	7	<i>C. attenuata rubricosa</i>
36	Assam	20	<i>C. attenuata rubricosa</i>
37	Burma	8	<i>C. attenuata</i>
38	Malaya	16	<i>C. malayana</i>
39	Borneo	7	<i>C. fuliginosa baluensis</i>
40	Christmas Island (10°31' S, 105°33' E)	10	<i>C. fuliginosa trichura</i>
41	Yunnan	8	<i>C. dracula</i>
42	Yunnan	4	<i>C. suaveolens</i>
43	N. Vietnam	20	<i>C. dracula</i>
44	China	9	<i>C. attenuata attenuata</i>
45	Korea	16	<i>C. suaveolens shantungensis</i>
46	Korea	15	<i>C. lasiura</i>
47	Japan	14	<i>C. russula dsinezumi</i>



FIG. 1. Distribution map of samples entered in the canonical variate analysis.

METHODS

Characters were taken exclusively from skins and skulls because there are very few shrew skeletons in the BMNH collections, while the paucity and age of alcoholic specimens preclude the use of anatomical characters such as those of the male reproductive tract which have been used successfully by other authors (Vinogradov, 1958; Martin, 1967). The following characters were examined with the abbreviations used in the text in brackets.

Head and body length (HB)
 Tail length (TL)
 Hindfoot length
 Ear length
 Weight
 Colour of pelage
 Condylbasal length (CBL)
 Length of upper tooththrow (UTL)
 Combined length of upper incisor and unicuspid
 Lingual length of upper unicuspid
 Labial length of upper unicuspid at cingula (LLU)

Width across maxillae at level of second molar (MB)
 Height of rostrum
 Lacrymal breadth
 Interorbital breadth (IB)
 Postglenoid breadth (PB)
 Braincase breadth (BB)
 Height of braincase
 Length of mandible (excluding incisor)
 Height of mandible at coronoid process
 Length of mandibular tooththrow (excluding incisor)
 Shape of teeth

Skin measurements were taken from collectors' notes on the specimen labels, which are notoriously fallible because they are difficult to measure accurately and consistently and the measuring technique varies from one collector to another. However, skin measurements are still useful as long as these disadvantages are taken into account and since they have been extensively used in the taxonomy of this group their inclusion was considered necessary. The effect of using skin measurements was checked by running the CVA twice, first including head and body, tail and hindfoot length and secondly omitting these three characters. The results were found to be comparable so only the former analysis is described here.

The tooththrow and anterior part of the skull are less frequently damaged than the posterior. Since the CVA requires possession of all characters by each specimen either the number of specimens or number of characters had to be reduced; the latter course was considered preferable. The excluded characters were examined and incorporated with the results of the CVA at a later stage. The following characters were selected for the CVA and found to show little correlation with each other (see Table 2):

1. Length of upper tooththrow;
2. Combined length of upper incisor and unicuspid;
3. Lingual length of upper unicuspid;
4. Labial length of upper unicuspid at cingula;
5. Width across maxillae at level of second molar;
6. Head and body length;
7. Tail length;
8. Hindfoot length.

TABLE 2

Correlation matrix of characters used in the canonical variate analysis

Character	No.								
Length of upper tooththrow	(1)	1.00							
Combined length of upper incisor and unicuspid	(2)	0.43	1.00						
Lingual length of upper unicuspid	(3)	0.60	0.40	1.00					
Labial length of upper unicuspid at cingula	(4)	0.55	0.38	0.60	1.00				
Width of maxillae at level of second molar	(5)	0.50	0.22	0.34	0.32	1.00			
Head and body length	(6)	0.20	0.09	0.12	0.16	0.27	1.00		
Tail length	(7)	0.35	0.08	0.28	0.27	0.24	0.32	1.00	
Hindfoot length	(8)	0.33	0.15	0.24	0.24	0.29	0.30	0.37	1.00
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	

The CVA programs used were part of the CLASP package provided by J. C. Gower, Statistics Department, Rothamsted Experimental Station. The data, which may be thought of as a 'plot' in eight dimensions, are translated into visible form by the following treatment. The CVA program seeks a plane in this eight-dimensional space which, when the group means are projected on to the plane, best reproduces

the Mahalanobis' distances between groups. The Mahalanobis' generalized distances (D^2) are akin to phenetic distances but take some account of intraspecific variation and correlation of characters (see Sneath & Sokal, 1973). If the variation between the projected group means is almost as large as the total variation in eight dimensions then the representation on the plane will be a good one. In the first analysis (a) the variation on the plane was 84% of the total and therefore the plot of group means on this plane gives a fairly accurate overall picture of the relationships between them.

The following relevant information is produced by the program: (1) Correlation matrix between characters for all specimens. (2) Distance matrix (D^2) or Mahalanobis' distances which are an index of dissimilarity between OTUs (see Table 8).

CANONICAL VARIATE ANALYSIS

(a) FIRST ANALYSIS OF ALL OTUs

The results of the first analysis are summarized in Fig. 2, in which OTUs are plotted on a plane which accounts for 84% of the variation, suggesting a reasonable representation of the actual relationships. Circles are calculated to include 90% of the individual specimens that combine to give the group mean, while the boundaries of currently recognized species groups are indicated by lines of differing texture (see key on figure).

OTUs Malaya (38), Borneo (39), Yunnan (41) and N. Vietnam (40) overlap but are well separated from all others and may be regarded as a distinct species, hereinafter referred to as *C. fuliginosa*. The remaining groups are disposed in a Y-shaped pattern, those at the extreme of each limb being clearly distinct.

(1) Top right – Darjeeling (34), Bhutan (35), Assam (36), China (44) correspond with *C. attenuata*, and Christmas Island specimens (40), *C. fuliginosa trichura*, are associated with this group. Burma (37) is also usually thought to belong to this species and is positioned closest to it despite showing no overlap at the 90% level.

(2) Lower centre – Isles of Scilly (1), Jersey and Sark (2), Rumania and Hungary (18), Yugoslavia (19), Greece (21), Russian Turkestan (30), Yunnan (42) and Korea (45) correspond with the classic concept of *C. suaveolens*. Showing overlap with this group is Pakistan (29) currently regarded as a distinct species, *C. zarudnyi*. Sri Lanka (33), *C. horsfieldi*, lies close to this group but does not overlap with it. *C. dsinezumi* from Japan (47) overlaps with *C. suaveolens*, *C. russula* and *C. zarudnyi*.

(3) The remainder form a central group extending to the top left which corresponds with the *russula-leucodon* complex, with *leucodon* falling at the extreme left. Those in the upper portion of this group include specimens from Turkey (23) and also Israel and Lebanon (26) and Iran (27) whose affinities are doubtful. The Korean OTU (46), *C. lasiura*, overlaps with the group at the extreme upper left.

(b) SECOND ANALYSIS OF 42 OTUs (5 OMITTED)

The analysis was repeated but five OTUs were omitted to improve resolution (see Fig. 3). Those excluded were Malaya (38), Borneo (39), Yunnan (41) and

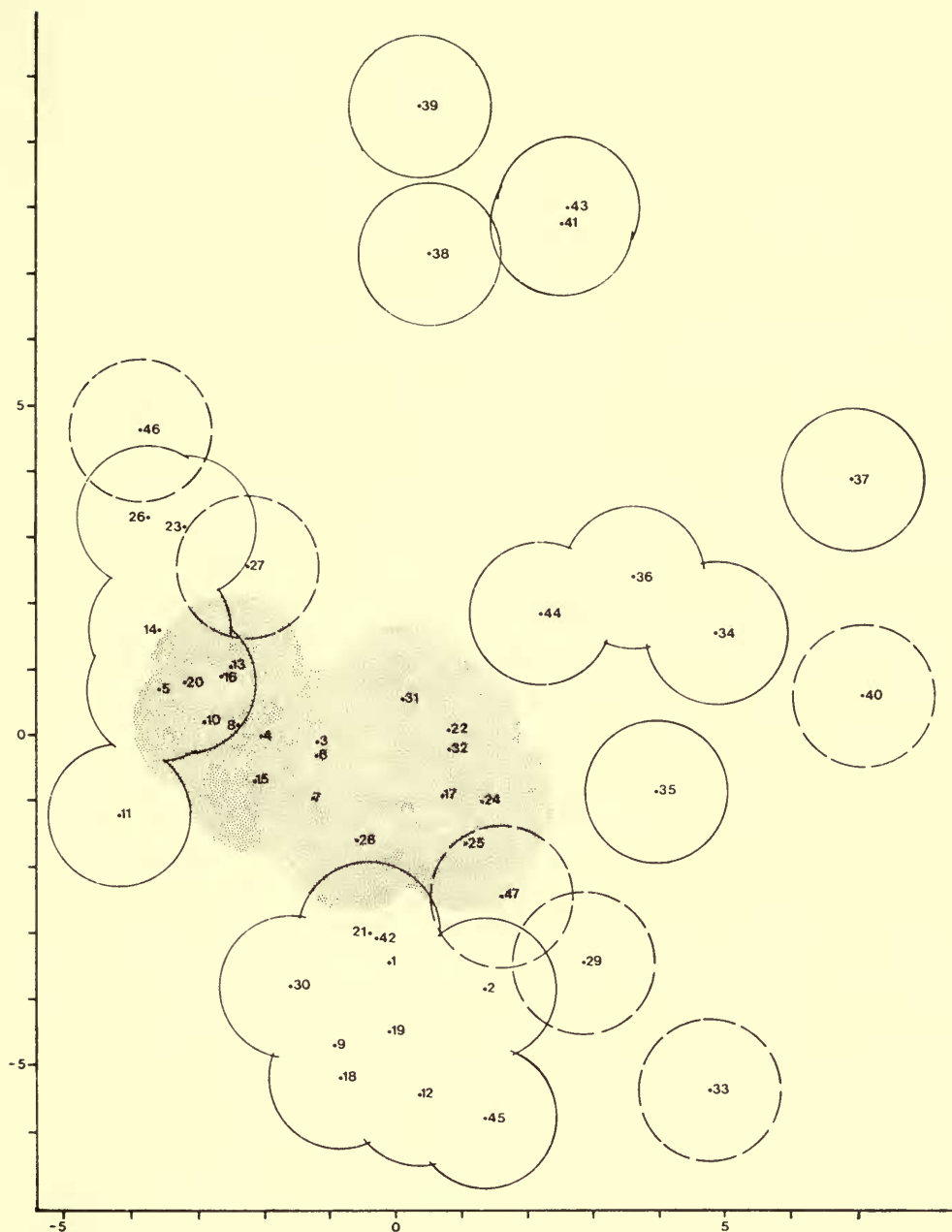


FIG. 2. First analysis of all OTUs.

C. fuliginosa – upper centre of figure; *C. russula* – central group (stippled); *C. leucodon* – extreme left of central group; *C. attenuata* – extreme right of central group; *C. suaveolens* – lower centre of central group; other species currently regarded as distinct – broken circles.

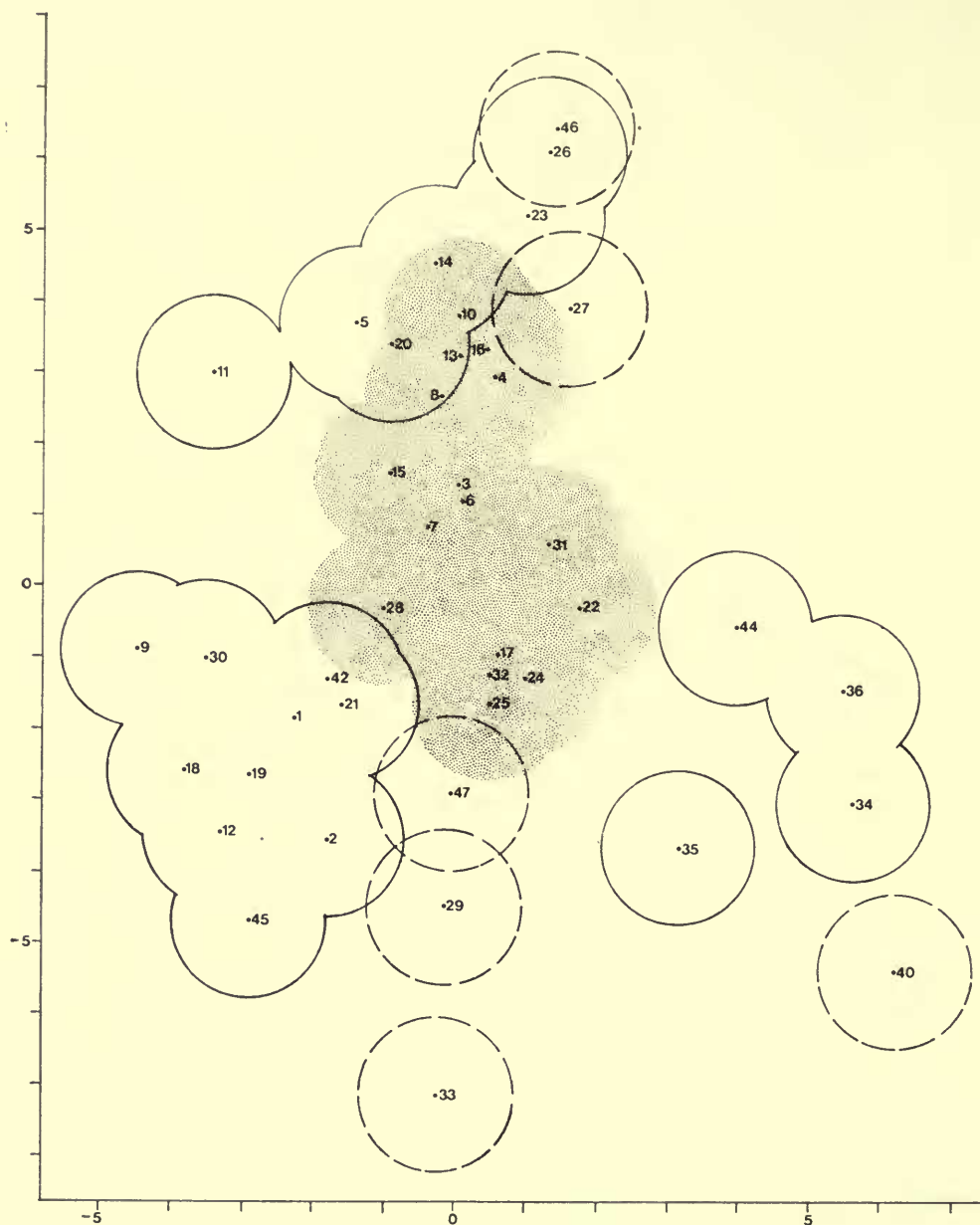


FIG. 3. Second analysis of 42 OTUs.

C. russula – central group (stippled); *C. leucodon* – upper left of central group; *C. attenuata* – lower right of central group; *C. suaveolens* – lower left of central group; other species currently regarded as distinct – broken circles.

N. Vietnam (42) which form a distinct group, *C. fuliginosa*, and also Burma (37) which is separated from any other OTU.

The plane in this analysis includes 82% of the variation. The species groups still overlap but to a lesser extent.

(1) Lower right – OTUs Darjeeling (34), Bhutan (35), Assam (36), China (44) form the loosely knit *C. attenuata*, with which Christmas Island (40) is associated.

(2) Lower left – OTUs overlapping in the *suaveolens* group remain as before. *C. zarudnyi* overlaps with this group and *C. dsinezumi* overlaps with both groups and also with *C. russula*.

(3) The *russula-leucodon* complex is better spaced in this figure. *C. russula* falls roughly into two subgroups with most European OTUs in the upper part of the figure and Asian ones occurring lower down. *C. leucodon* lies at the top left.

IDENTIFICATION

All available information including that from the previous section is assembled here and correlated with the existing taxonomic groupings. The species recognized are :

Crocidura fuliginosa – including *malayana*, *baluensis* and *dracula*.

Crocidura horsfieldi

Crocidura suaveolens

Crocidura zarudnyi

Crocidura russula – two groups

Crocidura dsinezumi

Crocidura attenuata – including *C. fuliginosa trichura*

Crocidura leucodon – two groups

Crocidura lasiura

In any one locality where two or more species occur they are usually easy to separate. An exception to this is found in Switzerland where three species occur. *C. suaveolens* is readily distinguished but *C. russula* and *C. leucodon* are only clearly separable on the basis of pelage colour.

In the majority of species some populations show overlap with at least one other species and therefore an exclusive diagnosis covering the entire region is impossible. Even when the range of the genus is divided into 'European', 'eastern Asian' and an intermediate zone from Turkey east to Sri Lanka, the construction of keys presents considerable difficulties. For example, the separation of *fuliginosa* from other species of *Crocidura* depends mainly on skull length. Although the key is somewhat unsatisfactory because of the overlap in size, the degree of separation is adequate in most cases, as may be seen in Fig. 4. A similar situation obtains in other examples of overlap.

Thus while the three keys given below are not a completely accurate identification guide, they may be used to discriminate with a reasonable degree of confidence between the species from a region, particularly when a series of specimens is available.

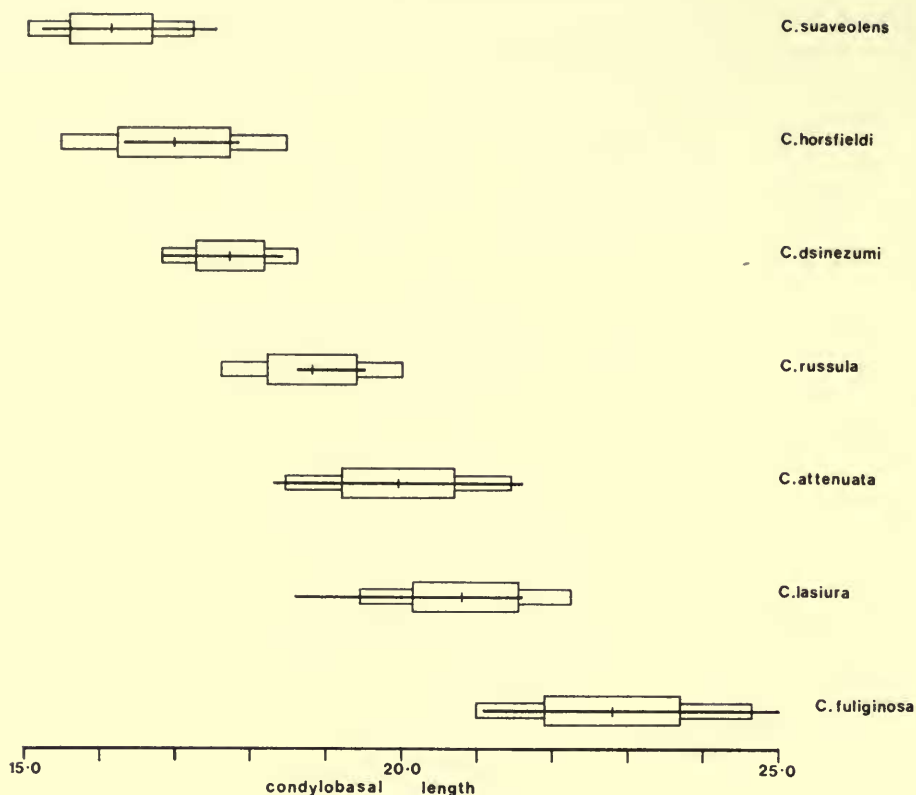


FIG. 4. Condylobasal length in species of *Crocidura* from eastern Asia, showing mean (vertical bar), range (horizontal line), one and two standard deviations (rectangles).

Confirmation of identification should be sought by reference to the additional data provided in the text.

1. KEY TO THE EUROPEAN SPECIES OF *CROCIDURA*

- 1 Bicoloured, pale ventral surface sharply differentiated from dark dorsum along flanks *C. leucodon*
- No sharp differentiation between dorsal and ventral colour 2
- 2 Average smaller, labial length of upper unicuspid up to 2.0 mm *C. suaveolens*
- Average larger, labial length of upper unicuspid usually over 2.0 mm *C. russula*

Note. (a) Where *C. suaveolens* and *russula* are sympatric, they may be distinguished on the basis of size and usually by differences in the shape of the large upper premolar.

(b) *C. russula* from Corsica may be distinguished from those from elsewhere in Europe by the distinctive shape of the large upper premolar (see text and Fig. 5), and from *C. suaveolens* only by a combination of several characters. However, *C. suaveolens* is not recorded from Corsica.

2. KEY TO THE SPECIES OF *CROCIDURA* OCCURRING FROM TURKEY IN THE WEST TO SRI LANKA IN THE EAST

- 1 Bicoloured, pale ventral colour differentiated from dark dorsal colour along flanks or, when unicoloured, size large (upper toothrow over 8.8 mm, width across maxillae at M² over 6.0 mm) *C. leucodon*

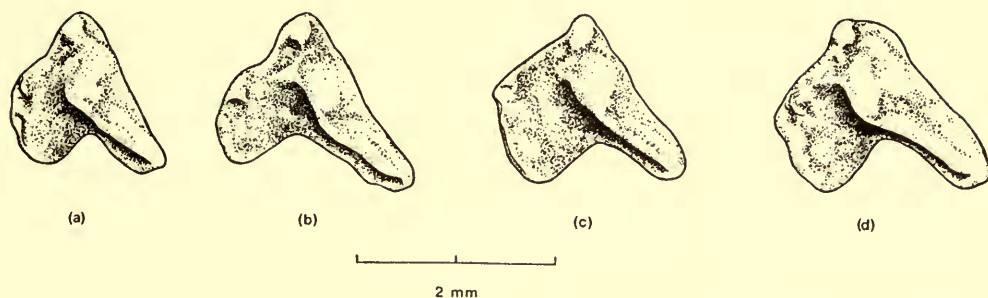


FIG. 5. Large upper premolar of European species of *Crocidura*. (a) *C. suaveolens* - Austria; (b) *C. russula* - Corsica; (c) *C. russula* - France; (d) *C. leucodon* - France.

- No sharp differentiation between dorsal and ventral colour; smaller (upper toothrow length less than 8.8 mm, width across maxillae at M^2 less than 6.0 mm) 2
- 2 Lingual region of large upper premolar relatively narrow and lobed (see Fig. 6); labial length of upper unicuspid greater than 1.8 mm ***C. russula***
- Premolar not so shaped, labial length of upper unicuspid less than 1.9 mm 3
- 3 Sri Lanka. Skull small and narrow, width across maxillae at M^2 less than 5.1 mm. Ratio of tail length to upper toothrow length 6.5-7.5 : 1 ***C. horsfieldi***
- Other localities. Width of maxillae at M^2 greater than 5.0 mm. Ratio of tail length to upper toothrow length 3.4-5.2 : 1 (*suaveolens*) or if greater (4.8-7.1 : 1) colour of pelage very pale (*zarudnyi*). ***C. suaveolens***
C. zarudnyi

Note. (a) The separation of *C. russula* and the unicoloured *C. leucodon caspica* from Iran is not complete as there is a small overlap in size of the characters used. However, most specimens seen can be identified by the key above.

(b) *C. suaveolens* and *C. zarudnyi* are difficult to distinguish, see discussion in text under *C. zarudnyi*.

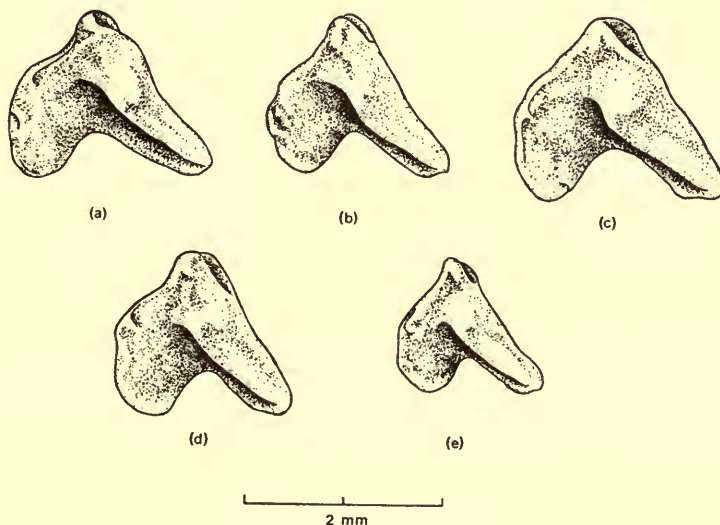


FIG. 6. Large upper premolar of species of *Crocidura* occurring from Turkey in the west to Sri Lanka in the east. (a) *C. suaveolens* - Russian Turkestan; (b) *C. russula* - Turkey; (c) *C. leucodon* - Turkey; (d) *C. zarudnyi* - Pakistan; (e) *C. horsfieldi* - Sri Lanka.

3. KEY TO EASTERN ASIAN SPECIES OF *CROCIDURA*

- 1 Large, condylobasal length over 21.0 mm *C. fuliginosa*
- Smaller, condylobasal length less than 21.6 mm, where greater than 21.0 mm, tail 48-58% of head and body length (*lasiura*) or 59-92% (*fuliginosa*). Only one specimen of *attenuata* has a condylobasal length greater than 21.0 mm - see Fig. 4 and text 2
- 2 Upper tooththrow length 9.0-10.2 mm, tail length 34-49 mm, 48-58% of head and body length, ear margins densely furred *C. lasiura*
- Upper tooththrow length 7.8-9.8 mm, tail length 50-88 mm, 69-108% of head and body length, ear margins not densely furred *C. attenuata*
- Upper tooththrow length 7.4-8.8 mm, tail length 37-51 mm, 54-76% of head and body length, ear margins not densely furred 3
- 3 Width of braincase over 8.8 mm *C. russula*
- Width of braincase usually less than 8.8 mm 4
- 4 Japanese, width of braincase 8.1-8.8 mm, condylobasal length over 16.8 mm *C. dsinezumi*
- Elsewhere, width of braincase less than 8.5 mm (if from Tsushima Islands or Korea, width of braincase less than 8.2 mm and condylobasal length less than 16.9 mm) 5
- 5 Ratio of tail length to upper tooththrow length less than 5.8 : 1 *C. suaveolens*
- Ratio of tail length to upper tooththrow length over 5.7 : 1 *C. horsfieldi*

Note. (a) Separation of *C. russula* from *C. attenuata* depends on a combination of characters, see text.
 (b) It is possible to distinguish *C. dsinezumi* from *C. suaveolens* occurring in nearby areas, see text.
C. dsinezumi is geographically separated from *C. russula* and *C. horsfieldi* and a combination of characters serve to distinguish these species.

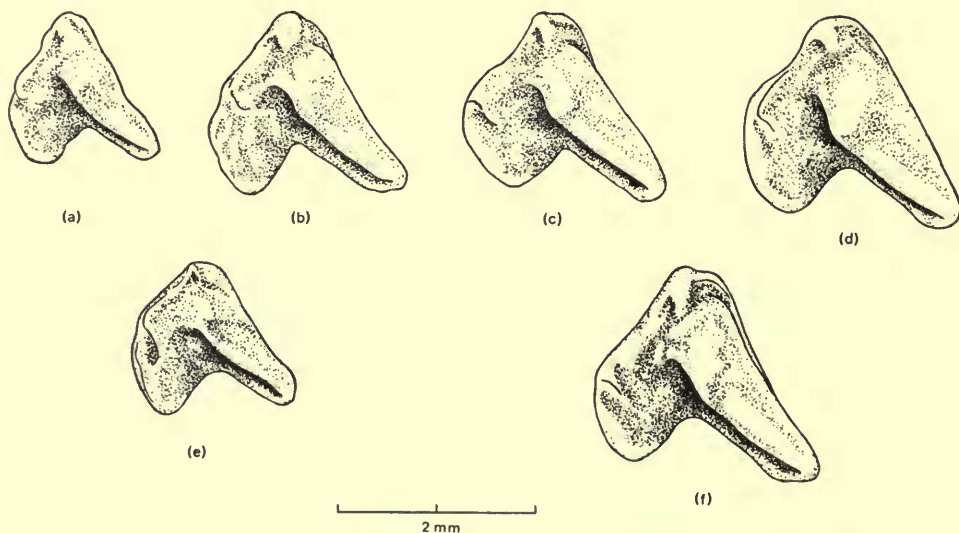


FIG. 7. Large upper premolar of *Crocidura* from eastern Asia. (a) *C. suaveolens* - Korea ; (b) *C. russula* - Punjab ; (c) *C. attenuata* - Assam ; (d) *C. lasiura* - Korea ; (e) *C. dsinezumi* - Japan ; (f) *C. fuliginosa* - N. Vietnam.

VARIATION AND SYSTEMATICS

Crocidura fuliginosa (Blyth, 1855)

This is the only group that is completely distinct from all others. It includes three forms previously regarded as separate species but here associated with *C.*

fuliginosa from Burma. These are *C. malayana* from Malaya (38), *C. baluensis* from Borneo (39) and *C. dracula* from Yunnan (41) and N. Vietnam (43).

Populations from Yunnan and N. Vietnam are very similar to each other and are currently known as *C. dracula*. They have a D^2 value of 1.5 which is very low and reflects their conspecificity. These populations resemble specimens from Borneo and Malaya which, with a D^2 value between them of 2.69, are also very similar. The range of D^2 values within the group goes up to 4.3 but this is still fairly low when the geographical distance between populations and ecological barriers are taken into consideration, see distribution map (Fig. 8).



FIG. 8. Distribution of *C. fuliginosa*. Broken lines – exact distribution uncertain.

The results of the CVA may be correlated with characters not employed in the numerical analysis. This group contains some of the largest specimens in the genus. Those from Borneo are the largest while the greatest size range occurs in Malaya. Populations from Yunnan and N. Vietnam, are more similar in appearance and size to each other than to populations from Malaya or Borneo. Size range is given in Table 6.

A large number of distinct species have been described from many of the separate islands off the Malay Peninsula. The BMNH houses most of the holotypes of these, which have been compared with mainland specimens and those from Borneo. The

holotypes fall within the range of this group. Some of these island forms may not even be distinct subspecies but no definite conclusions can be based on the few specimens available.

Unfortunately I have not seen the holotype of *C. fuliginosa* which was collected from Schwe Gyen, Pegu, Burma, and is lodged in the Calcutta Museum. Banks (1931) recorded it as the commonest lowland shrew in Borneo and Chasen (1940) accepted a brown form in the lowlands of Malaya as *fuliginosa* and a darker form as *malayana*.

The name *C. fuliginosa* is the subject of some confusion. Blyth's (1855) original description is rather scanty and there is some doubt whether the subsequent description by Anderson (1881) refers to the same specimen, especially as different terminology is used for measurements. The statement by Lindsay (1929) '... the specific name of *fuliginosus* which Blyth plainly applied to a *Suncus*' is erroneous since *Suncus* is defined as possessing four upper unicuspid. Medway (1965) has attempted to elucidate the situation but there is still some doubt about the identity of the holotype, particularly as some label mixing may have occurred in the past.

This report confirms the view of Medway (1965) who allocated Malayan specimens of *malayana* and Bornean *foetida*, *kelabit* and *baluensis* to *C. fuliginosa*. This name is also applicable to the large specimens from the offshore islands of Malaysia as well as to specimens of *dracula* from Yunnan and N. Vietnam.

C. fuliginosa is recorded from S. Vietnam by Van Peenan, Ryan & Light (1969) which suggests a fairly continuous distribution from Yunnan in the north, lower Burma, N. and S. Vietnam to the Malay Peninsula and Borneo (see Fig. 8). A limited number of specimens indicate that this species is also present on the islands of Sumatra, Java and Sulawesi.

The following subspecific groups are suggested in addition to *C. f. fuliginosa* from Burma :

Crocidura fuliginosa malayana Robinson and Kloss, 1911. Mainland of Malaya.

Probable synonyms of *C. f. malayana* from the offshore islands of the Malay Peninsula are :

Crocidura aoris Robinson, 1912. Aor Island.

Crocidura klossii Robinson, 1912. Great Redang Island.

Crocidura negligens Robinson & Kloss, 1914. Samui Island.

Crocidura maporensis Robinson & Kloss, 1916. Mapor Island.

Crocidura grvida Kloss, 1917. Dayang Bunting Island.

Crocidura tionis Kloss, 1917. Tioman Island.

Crocidura aagaardi Kloss, 1917. Bang Nara, Patani, southern Thailand.

Crocidura fuliginosa baluensis Thomas, 1898. Borneo.

Probable synonyms are :

Crocidura foetida Peters, 1870. Borneo. This name would predate *C. f. baluensis* as the correct subspecific name.

Crocidura fuliginosa kelabit Medway, 1963. Bario, Baram District, Sarawak.

Crocidura fuliginosa dracula Thomas, 1912. Yunnan.

Crocidura praedax Thomas, 1923. Likiang Valley, Central Yunnan.

Crocidura grisescens Howell, 1928. Kuatun, Fokien, South-eastern China (listed as a synonym of *C. dracula* by Ellerman & Morrison-Scott, 1966).

Crocidura dracula mansumensis Carter, 1942. Mansum, northern Burma.

Other species occurring in the same area as *C. fuliginosa*, but readily distinguished by their small size, are *C. suaveolens* in Yunnan and N. Vietnam (condylobasal length 15.2–17.5 mm) and *C. monticola* in Borneo (condylobasal length of one specimen only 15.2 mm). Condylobasal length of *C. fuliginosa* is over 21.0 mm. *C. attenuata* is also sympatric at least in the northern part of the range but is usually distinguishable on the basis of small size. While there are no members of both species from the same area in the BMNH collections, specimens from relatively close areas, such as *fuliginosa* from Yunnan and N. Vietnam and Chinese *attenuata*, are distinct. Overlap in size occurs in some large specimens of *attenuata* from Assam and Burma and a few small *fuliginosa* from Malaya.

Crocidura horsfieldi (Tomes, 1856)

Only one OTU of this species, Sri Lanka (33), was entered in the CVA. It is rather similar to *C. suaveolens* but can be distinguished by the following features: the skull is relatively short and narrow and in these proportions it is most similar to populations of *C. suaveolens* from Tsushima Island (Japan), N. Vietnam and Korea but considerably smaller than the remaining populations (see Table 3). The tail is proportionately much longer than in *C. suaveolens*, the ratio of tail length to upper toothrow length ranging from 3.4 to 6.1:1 in the latter and from 6.5 to 7.5:1 in *C. horsfieldi*. The upper premolar is small and comparatively narrow (see Fig. 6).

The distribution of the nominate form and the other subspecies of *C. horsfieldi* listed by Ellerman & Morrison-Scott (1966) is given in Fig. 9. Of these the holotype of *C. h. indochinensis*, in the BMNH collections, agrees very well with specimens of *C. horsfieldi* from Sri Lanka and there seems little doubt that it is correctly assigned to this species. There is also a single specimen of *C. watasei* and this too is very similar to Sri Lanka specimens; Imaizumi (1970) gives the Japanese distribution of this subspecies. Two skulls from Taiwan are larger than Sri Lanka specimens (see Table 3). Another subspecies, *C. h. wuchihensis*, described from Hainan, differs slightly from specimens from Sri Lanka (condylobasal length 15.5–15.7 mm, skull width 7.8 mm, tail 67% of head and body length).

The subspecies recorded are:

C. h. horsfieldi (Tomes, 1856). Sri Lanka.

C. h. indochinensis Robinson and Kloss, 1922. Dalat, S. Annam.

C. h. watasei Kuroda, 1924. Liukiu Islands.

C. h. tadae Tokuda and Kano, 1936. Kô-tô-shô, island E. of Taiwan.

C. h. wuchihensis Wang, 1966. Mt Wuchih, Hainan Island.

The only other species recorded from Sri Lanka is *C. miya* Phillips, 1929 which is a much larger shrew, condylobasal length of holotype 19.7 mm, upper toothrow

length 8.7 mm, braincase damaged but width across maxilla at second molar 5.9 mm (see p. 302).

TABLE 3

Size range of *C. horsfieldi*, *C. suaveolens*, *C. russula*, *C. zarudnyi* and *C. dsinezumi*

	Condylobasal length, mm	Upper toothrow length, mm	Width of maxillae at M ² , mm	Braincase breadth, mm
<i>C. horsfieldi</i> Sri Lanka	16.2-17.2	6.8-7.4	4.8-5.1	7.4-7.8
	\bar{x} 16.60	\bar{x} 7.05	\bar{x} 5.00	\bar{x} 7.60
Taiwan	17.8	7.5 and 8.0	5.5	8.5
<i>C. suaveolens</i> Korea,	15.2-16.9	6.7-7.7	4.7-5.3	7.0-8.2
Tsushima, N. Vietnam	\bar{x} 16.03	\bar{x} 7.17	\bar{x} 4.98	\bar{x} 7.74
Europe, Algeria, Russian	15.7-18.1	6.9-8.4	4.8-5.8	7.7-8.8
Turkestan, Yunnan	\bar{x} 16.89	\bar{x} 7.59	\bar{x} 5.28	\bar{x} 8.1
<i>C. russula</i> Asia	17.5-19.5	7.6-8.8	5.2-6.0	8.4-9.4
	\bar{x} 18.39	\bar{x} 8.28	\bar{x} 5.65	\bar{x} 8.91
Europe	17.5-20.1	7.6-9.2	5.4-6.5	8.5-9.5
	\bar{x} 18.79	\bar{x} 8.48	\bar{x} 5.89	\bar{x} 8.97
<i>C. zarudnyi</i> Pakistan,	16.1-18.8	7.1-8.3	5.0-5.5	7.8-8.5
Punjab, Turkey, Iran	\bar{x} 17.69	\bar{x} 7.78	\bar{x} 5.30	\bar{x} 8.25
<i>C. dsinezumi</i> Japan	16.8-18.4	7.4-8.1	5.1-5.9	8.1-8.9
	\bar{x} 16.03	\bar{x} 7.82	\bar{x} 5.50	\bar{x} 8.53

Crocidura suaveolens (Pallas, 1811)

The following OTUs are included in this species: Isles of Scilly (1), Jersey and Sark (2), Algeria (9), Switzerland (12), Rumania and Hungary (18), Yugoslavia (19), Greece (21), Russian Turkestan (30), Yunnan (42) and Korea (45).

The *suaveolens* group has a very large distributional range but geographical variation is not very pronounced and most Mahalanobis' distances are correspondingly low, varying from 2 to 3. The European group of Switzerland (12), Rumania and Hungary (18), Yugoslavia (19) and Greece (21) have low D² values of 2.03-2.87.

The Algerian, Russian Turkestan and Yunnan populations are similar in size to European ones; the remaining Asian populations from Korea, Tsushima (Japan) and N. Vietnam are on average smaller, see Table 3.

In this species there is rather more colour variation than in most of the others. Most are greyish-brown often with a slightly paler venter but certain populations, notably those occurring in arid habitats such as Russian Turkestan, Algeria and Israel, have a strikingly pale grey or fawn dorsum and a still paler venter.

Another character which is probably ecologically linked is the densely furred ear margins which distinguish Korean specimens (though nearby specimens from Tsushima, Japan, lack this character) and also specimens from Russian Turkestan, especially those from Semiretchensk. In Korea this character may be subject to a certain amount of seasonal variation; the ears of specimens in summer pelage in

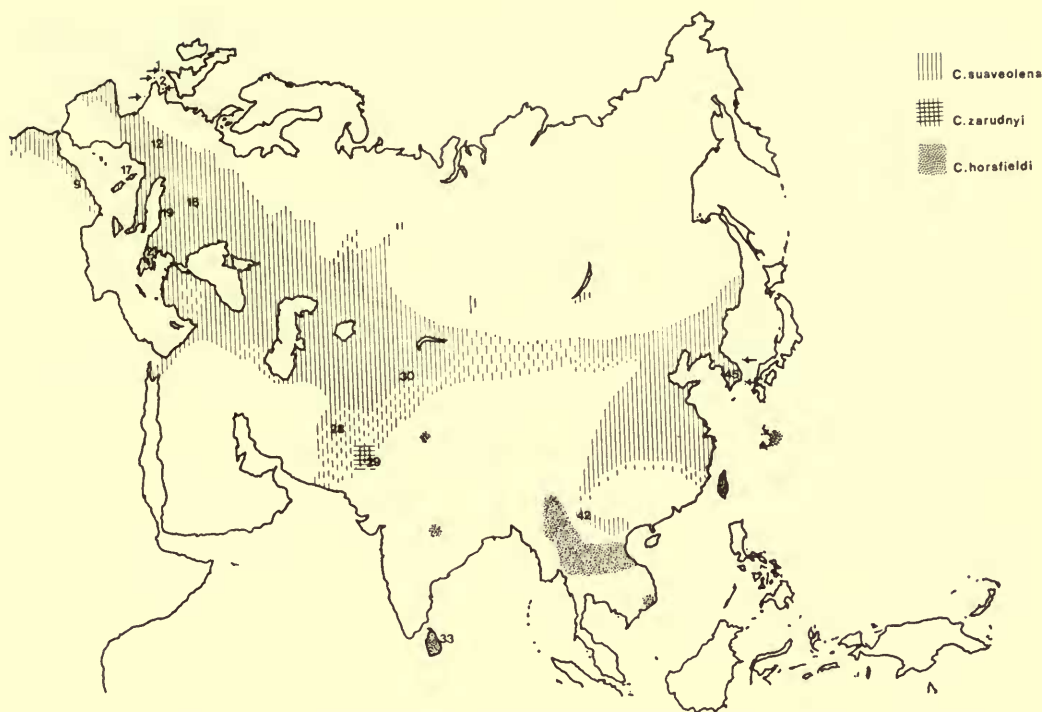


FIG. 9. Distribution of *C. suaveolens*, *C. zarudnyi* and *C. horsfieldi*. Broken lines—exact distribution uncertain.

August, September and early October are only slightly haired, while by late November, December and January specimens have winter pelage and densely furred ears.

Geographical proximity does not always correspond with low values of D^2 , especially where ecological barriers are involved. For example, island populations such as the Isles of Scilly (1) and Jersey and Sark (2) are relatively close to each other but the D^2 value is 3.15. Specimens from the Isles of Scilly are most similar to those from Yugoslavia (19), with a D^2 value of 1.96, while those from Jersey and Sark are most similar to Pakistan (29) specimens of *C. zarudnyi* with a D^2 value of 2.94. Delany & Healy (1966), in their study of *Crocidura* of the Channel Islands and the Isles of Scilly, also found that populations from Jersey and Sark can be distinguished from each other and that Channel Island populations are very distinct from those from the Isles of Scilly.

In summary, European mainland populations are generally more homogeneous than the island populations, the Algerian or the Asian populations which are sampled from well-separated areas. However, despite this geographical variation there is little doubt that the populations are truly representatives of one very widespread species probably with an almost continuous distribution over its range (see Fig. 9).

Of the subspecies listed from the Palaearctic and Indian region by Ellerman & Morrison-Scott (1966), the U.S.S.R. by Gureev (1971), China by Allen (1938) (listed under *C. ilensis*) and Japan by Imaizumi (1970), the following have been examined :

C. s. mimula Miller, 1901b. Western Europe (12, 18, 19, 21).

C. s. cassiteridum Hinton, 1924. Isles of Scilly (1).

C. s. whitakeri de Winton, 1897. Morocco, Algeria (9).

C. s. ilensis Miller, 1901c. Russian Turkestan to Mongolia (30).

C. s. shantungensis Miller, 1901c. Korea, Tsushima Islands (Japan), China (45).

Also samples from Jersey and Sark (2) and Yunnan (42).

Mahalanobis' distances between some populations of *C. suaveolens* (Isles of Scilly (1), Yugoslavia (19), Greece (21), Russian Turkestan (30) and Yunnan (42))

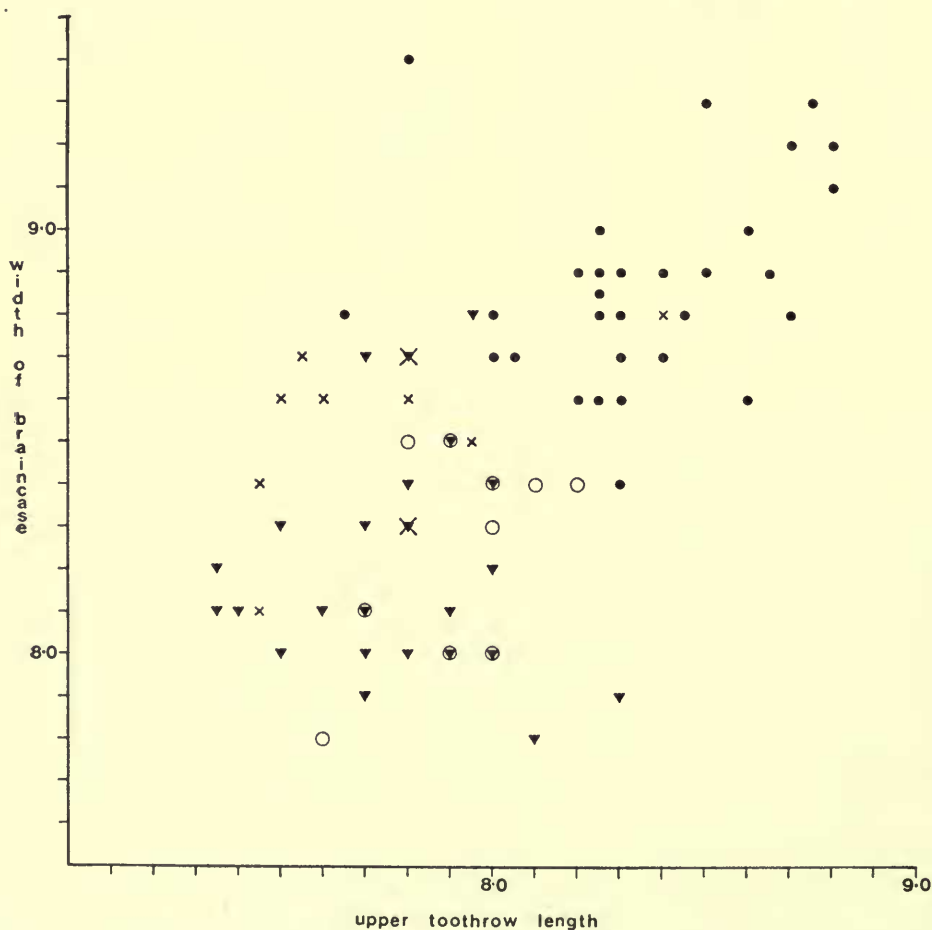


FIG. 10. Comparison of skull size.

C. russula (Asia and Corsica) ● ; *C. suaveolens* (Isles of Scilly, Greece, Russian Turkestan, Yunnan) ▼ ; *C. dsinezumi* × ; *C. zarudnyi* ○.

and others of the Asian subgroup of *russula* (Lebanon (24), Israel (25), Afghanistan (28) and Punjab (32) and also Corsica (17)) range from 2.25 to 5.48. Some of these are fairly low but since the sample populations are geographically well separated their similarity is unlikely to reflect any true relationship. Yunnan (42), for example, has D^2 values under 3.0 with Afghanistan (28), Corsica (17), Punjab (32), Lebanon (24) and Israel (25); Afghanistan has D^2 values under 3.0 with the Isles of Scilly (1), Russian Turkestan (30) and Yunnan (42).

Compared with Asian and Corsican *russula* these populations of *suaveolens* have somewhat smaller skulls (see Fig. 10 and Table 3) and shorter tails (TL 27–48 mm, \bar{x} 35.3 mm; in the Asian and Corsican *russula* TL 36–52 mm, \bar{x} 44.79 mm).

Richter (1970) decided to treat the entire species of *C. suaveolens* as a third sub-specific group of *C. russula*, the other two being *russula* and *gueldenstaedti*. He postulated that the *suaveolens* subspecies group is merely a 'steppe form' of the *gueldenstaedti* subspecies group and that *suaveolens* has only secondarily come to inhabit the area occupied by the *russula* subspecies group in western Europe. While it is true that some populations of *suaveolens* mentioned above are similar to some members of Richter's *gueldenstaedti* subspecies group, it is possible to distinguish the two species where they occur together. Furthermore, there is usually no difficulty in distinguishing *suaveolens* from the subspecies that Richter places in the *russula* subspecies group, especially where they are sympatric, so *C. suaveolens* should be treated as a separate species.

Crocidura zarudnyi Ognev, 1928

Crocidura pergrisea Miller, 1913

One OTU of *C. zarudnyi* from Pakistan (29) was entered in the CVA but several specimens from other localities were also examined. Because only two specimens of *C. pergrisea* were seen, they were not placed in the CVA but they have been examined and are briefly commented on here.

Specimens from Pakistan are currently regarded either as a distinct species, *C. zarudnyi* Ognev, 1928, type locality Baluchistan border (see Hassinger, 1970; Spitzenberger, 1971), or as a subspecies of *C. pergrisea* Miller, 1913 from Baltistan (see Ellerman & Morrison-Scott, 1966). The Pakistan (29) specimens are geographically fairly close to specimens of *C. suaveolens* from Russian Turkestan (30) and to Asian *russula* from Afghanistan (28) and Punjab (32), although they are probably ecologically isolated by the rocky, desert habitat and the surrounding mountainous terrain. The D^2 values between Pakistan (29) and Punjab (32) and Israel (25) are fairly low, 3.5, but the Pakistan specimens are most similar to those of *C. suaveolens* from Jersey and Sark (2) with a D^2 value of 2.94. Despite the similarity to various populations of *C. suaveolens* from Greece, Russian Turkestan, Yunnan, the Channel Islands and the Isles of Scilly, the only relevant comparison is with the Russian Turkestan specimens of *C. suaveolens* which have shorter tails on average (TL 27–40 mm, \bar{x} 32.2 mm; in *C. zarudnyi* 36–57 mm, \bar{x} 49.2 mm). The shape of the upper premolar is similar to that of specimens of Asian *C. russula*, though it is slightly smaller (see Fig. 6).

Miller (1913) described four specimens from Skoro Loomba, Shigar, Baltistan (2900 m), giving them the name *C. pergrisea*. Ognev (1928) first used the name *C. zarudnyi* for a new species which he had formerly described under a preoccupied name (1921). This new species, represented by one specimen, was collected in East Iran on the Baluchistan border.

Ellerman & Morrison-Scott (1966) examined three specimens from Baluchistan which they believed to be *zarudnyi* and placed this as a subspecies of *pergrisea*. Lay (1967) allocated to *C. pergrisea* six specimens from Iran, which Hassinger (1970) re-identified as *C. zarudnyi*. Hassinger made a preliminary study of the *C. zarudnyi-pergrisea* group and concluded that they were distinct species. He also described a new subspecies, *C. zarudnyi streetorum*, from Afghanistan.

Richter (1970) tentatively assigned both *zarudnyi* and *pergrisea* to the subspecies group *gueldenstaedti* of *C. russula*. Spitzenberger (1971) gave measurements of three subspecies of *C. pergrisea* (the nominate form *C. p. pergrisea*, *C. p. serezhkeyensis* Laptev, 1929 from the Pamirs and a new subspecies from Turkey, *C. p. arispa*) as well as *C. zarudnyi* and distinguished them from both *C. russula* and *C. suaveolens* by the light colour of the pelage and the relatively long tail. Gureev (1971) also recorded *C. zarudnyi* as a separate species from *C. pergrisea*. Hassinger (1973) amplified his previous discussion by comparing Afghan specimens with other species, still concluding that *C. pergrisea* and *C. zarudnyi* are two separate species. He distinguished *C. zarudnyi* from *C. russula* by its smaller size and from both *C. russula* and *C. suaveolens* by the relatively long tail and pale coloration. The habitat of *C. zarudnyi* in Afghanistan is reported to be drier than that of either *C. russula* or *C. suaveolens*.

TABLE 4

Comparison of various samples of *C. zarudnyi* with *C. pergrisea*

	Condylbasal length mm	Upper toothrow length mm	Width of braincase mm	Length of mandible- excluding I ₁ mm	Source when not measured personally
<i>C. zarudnyi</i> holotype	18.8	8.3	8.3	—	Ognev (1928)
<i>C. zarudnyi</i> Pakistan n = 11	16.1-18.7 \bar{x} 17.6	7.15-8.2 \bar{x} 7.8	7.8-8.5 \bar{x} 8.3	8.7-9.2 \bar{x} 9.0	
<i>C. zarudnyi</i> Iran n = 2	17.4, 18.7	7.8, 7.9	8.0, 8.3	9.0, 9.2	
<i>C. zarudnyi</i> Punjab n = 1	—	7.5	—	8.9	
<i>C. pergrisea arispa</i> holotype Turkey	17.7	7.5	8.25	9.0	
<i>C. p. pergrisea</i> Baltistan original series	19.0-19.4	8.6	8.8-8.9	—	Miller (1913)
<i>C. p. pergrisea</i> Baltistan n = 2	19.2	8.4	8.8	9.6, 9.7	

Table 4 shows that Baltistan specimens of *C. p. pergrisea* (two specimens measured personally plus measurements from the original description) are distinctly larger in most characters than all populations of *C. zarudnyi*. On these criteria the holotype of *C. p. arispa* from Turkey should be placed in the latter group as *C. zarudnyi arispa*. Although the specimens from Baltistan might be considered as a montane form of *zarudnyi* and, despite the fact that three specimens are not an adequate sample from which to draw conclusions, they are probably best regarded as examples of a distinct species, *C. pergrisea*.

Although rather similar to the Asian subgroup of *C. russula*, specimens of *C. zarudnyi* may usually be separated on size (see Fig. 10 and Table 3) as well as colour and labial length of upper unicuspid (1.45–1.9 mm, \bar{x} 1.77 mm in *C. zarudnyi*; 1.8–2.3 mm, \bar{x} 2.16 mm in Asian *C. russula*). However, separation from *C. suaveolens* is not so easy, the only useful characters being the pale pelage colour of *C. zarudnyi* which is paralleled by several populations of *C. suaveolens* from Russian Turkestan, Algeria, Israel and also specimens from Central Gobi, Mongolia, described by Allen (1938) under the name of *C. ilensis lar* (which Ellerman & Morrison-Scott (1966) believed to be a subspecies of *suaveolens*). This character may reflect adaptation to local environment rather than phylogenetic affinity. The other character is the relatively long tail which is also not an exclusive character (ratio of TL:UTL 3.4–5.2:1 in *C. suaveolens*; 4.8–7.1:1 in *C. zarudnyi*). Both *C. suaveolens* and *C. zarudnyi* have been recorded from Iran (Lay, 1967), Turkey (Spitzenberger, 1970, 1971) and Afghanistan (Hassinger, 1970, 1973) but not from the same habitats, and while the mean skull size is usually greater for specimens of *C. zarudnyi* than *C. suaveolens* the only distinct character is the greater tail length of the former. The evidence suggests that *C. zarudnyi* is fairly closely related to *C. suaveolens* and may be simply an ecological form of it, but for the present it is retained as a distinct species.

Crocidura russula (Hermann, 1780)

The OTUs that belong to this species fall into two groups roughly equivalent to a geographical division into European and Asian forms, except that the Corsican (17) population appears to belong to the latter group and Algeria to the former. Apart from these anomalous OTUs the European group consists of Guernsey and Alderney (3), France (4), Spain (6), Portugal (7), Germany, Belgium and Holland (10), Switzerland (13), Sicily (15), Sardinia (16) and also Algeria (8); the Asian group includes Turkey (22), Lebanon (24), Israel (25), Afghanistan (28), Kashmir (31) and Punjab (32).

Fig. 11 gives the distribution of this species and shows the wide geographical separation of the two subgroups. The main characters for distinguishing these groups are the differences in relative tail length, length of the upper unicuspid (LLU 2.0–2.5 mm, \bar{x} 2.25 mm; TL 28–46 mm, \bar{x} 38.35 mm in the European/Algerian group; LLU 1.8–2.3 mm, \bar{x} 2.16 mm; TL 36–51 mm, \bar{x} 45.33 mm in the Asian group). The premolar in mainland European populations has a very broad, squarish lingual portion in comparison with the narrow lobed appearance



FIG. 11. Distribution of *C. russula*, *C. dsinezumi* and *C. attenuata*. Broken lines – exact distribution uncertain.

characteristic of the Asian subgroup and Corsica (see Figs 5, 6 and 7). Skull size in the Asian subgroup is also on average slightly smaller than in the European/Algerian group, see Table 3.

OTUs of the European subgroup are fairly similar to each other with D^2 values of 1–3. In particular Spain (6) and Portugal (7) are very alike with a D^2 of 1.23, as are France (4) and Germany, Belgium and Holland (10) with a D^2 of 1.42. The Algerian population, although separated from the European mainland and Sardinia, is nevertheless very similar as reflected by the low D^2 values of 2.42–2.86.

As in *C. suaveolens* the greatest variation is shown by island populations, especially Sicily (15), Sardinia (16) and Corsica (17) where the D^2 values range from 3.92 between Sicily and Corsica, 3.95 between Sicily and Sardinia and 5.74 between Sardinia and Corsica. Specimens from Sicily have short narrow skulls in comparison with those from Sardinia which also have fairly well-spaced upper unicuspid (see Table 5). Specimens from Sicily are most similar to Spanish specimens with a D^2 value of 1.96, while those from Sardinia are closest to those from France and Germany, Belgium and Holland with D^2 values respectively of 2.14 and 2.2.

In spite of their close proximity to Sardinia and the European mainland, Corsican specimens show much more similarity to the Asian subgroup than to the European

one. D^2 values between Corsica and the Asian subgroup are very low, varying from 1.44 to 2.33, while the lowest D^2 between Corsica and any member of the European group is 2.89 for Spain. The Corsican population is compared with those from Sicily and Sardinia in Table 5. However, the resemblance of the Corsican population to members of the Asian subgroup is unlikely to indicate a correspondingly close relationship. It is more likely to be allied to European mainland and nearby island populations despite the dissimilarity, which is probably a reflection of an isolated island population evolving along different lines.

TABLE 5

Variation between island populations of *C. russula*

	Corsica (n = 15)	Sicily (n = 5)	Sardinia (n = 9)
Condyl basal length, mm	17.5-19.1 \bar{x} 18.10	18.0-18.3 \bar{x} 18.10	18.3-19.1 \bar{x} 18.75
Upper toothrow length, mm	7.7-8.7 \bar{x} 8.21	8.1-8.3 \bar{x} 8.23	8.3-8.9 \bar{x} 8.62
Labial length of unicuspid, mm	1.9-2.3 \bar{x} 2.06	2.1-2.2 \bar{x} 2.16	2.3-2.5 \bar{x} 2.42
Braincase breadth, mm	8.4-8.9 \bar{x} 8.72	8.5-8.7 \bar{x} 8.63	9.0-9.3 \bar{x} 9.16
Tail length, mm	4.0-4.9 \bar{x} 4.48	3.1-4.1 \bar{x} 3.50	3.3-4.0 \bar{x} 3.67

The Asian subgroup of *C. russula* has a wide distribution but shows very low D^2 values of 1-2. The adjacent Israel (25) and Lebanon (24) populations are very similar, with a D^2 value of 1.68, and although geographically separated, populations from Lebanon and Punjab (32) are also similar with a D^2 value of 1.83. Although geographically fairly close together Punjab and Kashmir (31) differ slightly, for while Punjab is fairly typical of the group Kashmir specimens are at the upper limit of the size range (e.g. UTL 7.4-8.7 mm, \bar{x} 8.25 mm for Punjab; 8.6-8.8 mm, \bar{x} 8.73 mm for Kashmir).

The earliest name for the Asiatic group is *C. gueldenstaedti* Pallas, 1811 from the Caucasus. This form has been considered conspecific with European *C. russula* (from which it is geographically separated) by Kuzyakin (1944, 1965), Ellerman & Morrison-Scott (1966), Spitzenberger (1970), Felten, Spitzenberger & Storch (1973) and Richter (1970). The last placed East Mediterranean forms of *russula* in the same subspecies group as *gueldenstaedti*.

C. gueldenstaedti has been regarded as specifically distinct by Vinogradov (1958), Gureev (1971) and Kock (1974). Vinogradov presumably contrasted the structure of the external genitalia of both European *russula* and *gueldenstaedti*, although only producing evidence about the latter. The character he did use was the difference in relative tail length.

Without actually examining any specimens of *gueldenstaedti* from the Caucasus, I hesitate to use this name as the senior synonym of any of the subspecies listed here,

although accepting its usage by other authors for *C. r. monacha* of Turkey as probably correct. For the same reason it seems incorrect to use it as a blanket name as Richter did, especially as some of the subspecies he included in that group appear fairly distinct. Also it is not necessarily correct to ally Asian forms with Mediterranean island forms which may have originated from any of many possible sources and which are presumably fairly isolated genetically. For example, although Corsican animals very closely resemble populations from Lebanon and Punjab they are also similar to Spanish specimens (see above, p. 293).

The following subspecies have been examined and fall into two groups ; European group

C. r. russula (Hermann, 1780). European mainland (4, 10, 13).

C. r. pulchra Cabrera, 1907. Spain, Portugal (6, 7).

C. r. peta Montagu & Pickford, 1923. Guernsey, Herm and Alderney (3).

C. r. ichnusae Festa, 1912. Sardinia (16).

C. r. sicala Miller, 1901a. Sicily (15).

C. r. cyrenensis Miller, 1907. Corsica (17).

Associated with this group is

C. r. agilis Levaillant, 1867. Algeria (8).

Asian group

C. r. monacha Thomas, 1906 (probably *C. r. gueldenstaedti* Pallas, 1811 see above). Turkey (22).

C. r. pullata Miller, 1911. Kashmir (31).

Also samples from Lebanon (24), Israel (25) and Punjab (32).

The affinities of *C. russula* and *C. suaveolens* have been discussed previously under *C. suaveolens* and those of *C. russula* and *C. leucodon* are dealt with in the account of *C. leucodon*.

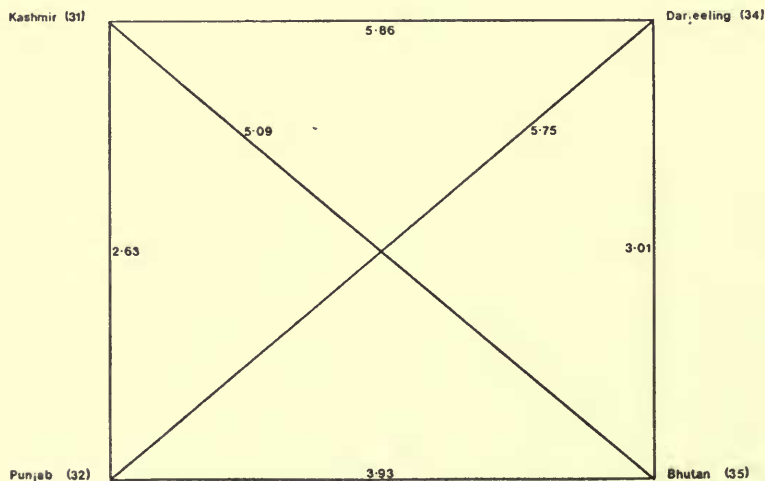


FIG. 12. D^2 values between the closest geographical populations of *C. russula* and *C. attenuata*.

C. attenuata may be distinguished from *C. russula* by the longer tail (TL 36–51 mm, \bar{x} 45.33 mm in Asian *russula*; 50–79 mm, \bar{x} 62.94 mm in *C. attenuata*). Kashmir (31) and Punjab (32) populations of the Asian subgroup of *russula* mark the eastern limit of this group, while Darjeeling (34) and Bhutan (35) are the westernmost populations of *C. attenuata*. The D^2 values between these four populations are shown in Fig. 12.

The lowest figure, which is between Punjab (32) and Bhutan (35), does not in this case represent great similarity as specimens from Punjab may usually be distinguished from Bhutan specimens by their slightly broader skulls and shorter tails (IB 4.2–4.5 mm, PB 6.0–6.4 mm, TL 40–51 mm in Punjab specimens of *C. russula*; IB 3.9–4.2 mm, PB 5.7–6.1 mm, TL 52–63 mm in Bhutan specimens of *C. attenuata*).

Crocidura dsinezumi Temminck, 1844

Specimens from Japan (47), currently regarded either as a distinct species, *C. dsinezumi*, or as a subspecies of *C. russula*, emerge in the CVA close to certain OTUs of both the Asian subgroup of *C. russula* and *C. suaveolens*. The Japanese specimens may be distinguished from their nearest neighbours of *C. suaveolens* occurring in Korea and Tsushima Islands, which are smaller, see Table 3. Although geographically well separated from other samples of *C. suaveolens*, the Japanese population shows low D^2 values with some OTUs, such as Jersey and Sark (2) and Greece (21), of 2.7. Low D^2 values are also shown between Japan and the Asian subgroup of *C. russula*, for example Punjab (32) with 2.7, Lebanon (24) with 2.8. The size of the skull is within the upper limits of *C. suaveolens* but only just within the lower limits of Asian *russula* (see Fig. 10), while the tail is relatively long and within the range of Asian *russula* (TL 37–50 mm, \bar{x} 44.6 mm).

The Japanese population was described as a distinct species, *C. dsinezumi*, but was treated as a subspecies of *C. russula* by Ellerman & Morrison-Scott (1966). Imaizumi (1970) regards *C. dsinezumi* as a distinct species and separable from *C. suaveolens* occurring in China, Korea and the Tsushima Islands. This view seems preferable and it is considered here to be a separate species.

Crocidura attenuata Milne-Edwards, 1872

This species includes the following OTUs: Darjeeling (34), Bhutan (35), Assam (36), Burma (37), China (44) and also Christmas Island (40). Specimens from Christmas Island have hitherto been assigned to *C. fuliginosa trichura*. The distribution of *C. attenuata* is shown in Fig. 11.

D^2 values between Darjeeling, Bhutan, Assam and China range from 2.43 to 3.47, which, while not as low as in some groups, nevertheless indicate a fairly high degree of relationship, especially when the geographical distances and variation in ecological conditions are taken into account. Darjeeling, Bhutan and Assam are at least partially isolated from each other by the mountainous terrain and separated from Burma and China by distance and differing habitats. The Burmese population is

separated from any group other than *C. attenuata* by very high values of D^2 . The lowest D^2 value is 4.84 with Assam and 4.91 with Darjeeling.

Christmas Island is a considerable distance from the main distribution area of *C. attenuata* but it shows relatively low D^2 values of 3.65–4.73 with Darjeeling, Bhutan, Assam and Burma. It shows no similarity to any other group entered in the CVA and may be readily distinguished from both the small and very large species of *Crociodura* occurring in Indonesia, which is the nearest area where shrews of this genus occur. A single specimen from Java and three from Sumatra closely resemble both Christmas Island specimens and other populations of *C. attenuata*, which suggests that this species may also be present, under different names and rarely recorded, in some parts of Indonesia. This would make the presence of *attenuata* in Christmas Island more likely, as a representative at the extreme limit of a species having a discontinuous distribution from Asia down through the Indonesian chain.

The Mahalanobis' distances are a reflection of the range of variation in this group, for example, in populations from Bhutan and Christmas Island the anterior part of the skull is fairly narrow (MB 5.2–5.9 mm, \bar{x} 5.5 mm) but the posterior part of the skull in the latter population is wider than in the former (PB 5.7–6.1 mm, \bar{x} 5.84 mm in Bhutan; 6.1–6.5 mm, \bar{x} 6.32 mm in Christmas Island) – see Fig. 13. Measurements for the species are given in Table 6.

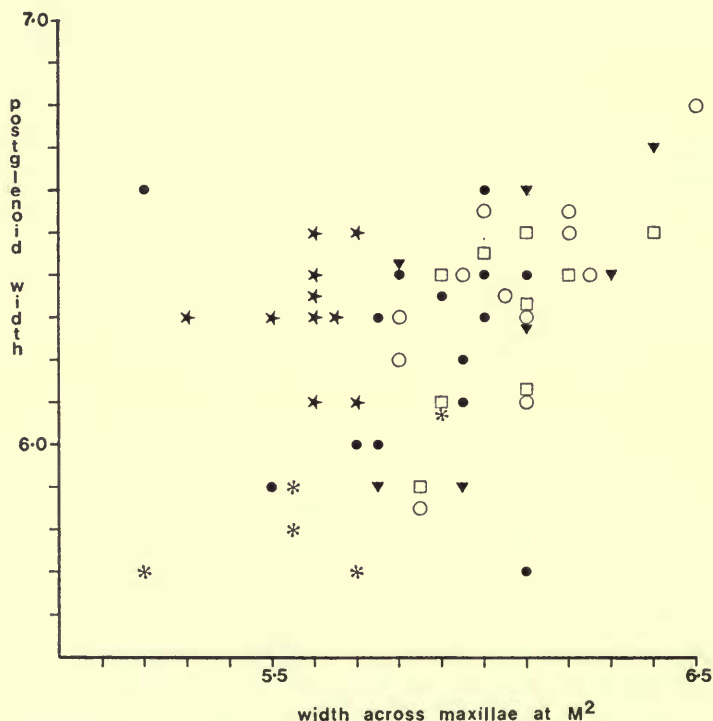


FIG. 13. Variation in skull width in populations of *C. attenuata*.

Darjeeling ●; Bhutan *; Assam ○; Burma □; China ▼; Christmas Island ★.

C. attenuata has apparently been confused with *C. fuliginosa* in the past and it seems likely that the latter name has been used at various times to refer to quite different animals. For example, Blanford (1888) synonymized *C. rubricosa* and *C. kingiana* (currently regarded as subspecies of *C. attenuata*) with *C. fuliginosa*, giving the distribution as Eastern Himalayas, Assam and Tenasserim (Burma). Thomas (1889) gave the distribution of *C. fuliginosa* as Himalayas through Burma to Java and in this paper Dobson described a new shrew from Christmas Island as a geographical race – *C. fuliginosa trichura*. The holotype and ten other specimens from Christmas Island are in the BMNH; information given above indicates close association with *C. attenuata* and certainly none with the group referred to as *C. fuliginosa* in this report. The correct name for the Christmas Island *Crocidura* is thus *C. attenuata trichura*.

The following subspecies have been examined :

C. a. attenuata Milne-Edwards, 1872. China and Hainan (44).

C. a. rubricosa Anderson, 1877. Assam, Himalayas (34, 35, 36).

C. a. trichura Dobson, 1888. Christmas Island (40) – formerly attributed to *C. fuliginosa trichura*.

Also a sample from Burma (37), an *attenuata* whose affinities are uncertain at sub-specific level.

The affinities of this species with members of the Asian subgroup of *C. russula* have been discussed previously under the latter species. Key 3 (p. 282) and Fig. 7 give the characters for separating *C. attenuata* from *C. fuliginosa* and others occurring in the area.

TABLE 6

Size range of *C. attenuata*, *C. leucodon*, *C. lasiura* and *C. fuliginosa*

	Condylobasal length, mm	Upper toothrow length, mm	Width of maxillae at M ² , mm	Braincase breadth, mm
<i>C. attenuata</i> Asia	18.3–20.6 x̄ 19.95	7.8–9.8 x̄ 8.79	5.2–6.5 x̄ 5.89	8.2–10.0 x̄ 9.12
<i>C. leucodon</i> France, Germany, Yugoslavia	17.8–19.9 x̄ 18.74	8.0–9.2 x̄ 8.60	5.7–6.5 x̄ 6.15	8.6–9.5 x̄ 9.11
Switzerland, Asia Minor	19.0–21.4 x̄ 19.96	8.8–10.2 x̄ 9.18	5.8–6.8 x̄ 6.29	8.8–10.2 x̄ 9.45
<i>C. lasiura</i> Korea	18.6–21.6 x̄ 20.77	9.2–10.3 x̄ 9.74	6.2–7.0 x̄ 6.85	9.1–10.2 x̄ 9.67
<i>C. fuliginosa</i> Asia, Malaysia	21.3–25.0 x̄ 22.80	9.4–11.5 x̄ 10.40	6.2–7.8 x̄ 6.90	9.5–11.1 x̄ 10.10

Crocidura leucodon (Hermann, 1780)

Fig. 14 gives the distribution of this species. The OTUs are: France (5), Germany (11), Switzerland (14), Yugoslavia (20), Turkey (23), Israel and Lebanon



FIG. 14. Distribution of *C. leucodon* and *C. lasiura*. Broken lines—exact distribution uncertain.

(26) and also Iran (27) which has hitherto been regarded as a subspecies of *russula*—*C. r. caspica*.

This is a loosely knit group exhibiting a large range in variation. Those showing greatest association are European populations from France (5), Germany (11) and Yugoslavia (20) which have D^2 values between 1 and 3. French and German populations in particular have crowded unicuspid (LLU 1.8–2.1 mm, \bar{x} 1.93 mm), while this measurement in the Yugoslavian population is 1.9–2.3 mm, \bar{x} 2.05 mm. Skins usually show a sharp delineation along the flanks between the dark dorsal and pale ventral colour.

Although hitherto believed to belong to *C. russula*, Iranian specimens can be readily distinguished from that group—see last section of this species account. The Iranian population is very similar to that from Turkey with a D^2 value of 2.4. Both Iranian and Turkish specimens on average have larger skulls with uncrowded unicuspid in comparison with their European counterparts (LLU 2.1–2.55 mm, \bar{x} 2.23 mm). Turkish specimens have a dark dorsum and paler venter although not so definitely bicoloured as European specimens, while Iranian specimens differ markedly in their very dark dorsal and ventral surface.

Specimens from Israel and Lebanon are most similar to those from Turkey and Iran, although the D^2 value is rather high. They fall within the range on skull size and the pelage colour resembles that of Turkish specimens.

Although Swiss specimens might be expected to be most similar to nearby populations from France and Germany, Mahalanobis' distances are from 3 to 4, while the D^2 values between Swiss and Turkish populations is 2.26 and between Switzerland and Iran 2.77.

Variation between the two subgroups is shown in Table 6.

Turkish specimens are associated with other OTUs in this group by D^2 values of 2–5 and they represent *C. leucodon lasia* which has a chequered history. It was originally described by Thomas (1906) as a subspecies of *C. leucodon*, though he later (1907) declared it distinct enough to be a full species – *C. lasia*. Bobrinskii *et al.* (1944) decided it was a subspecies of the Korean *C. lasiura*, an opinion with which Ellerman & Morrison-Scott (1951) concurred, although in the second edition Bobrinskii (1965) included it as a distinct species – *C. lasia*. Vinogradov (1958), examining the external genitalia, was unable to differentiate *lasia* from *C. leucodon* although *C. lasiura* was found to be distinguishable. Lay (1967) and Gureev (1971) also regard it as a subspecies of *C. leucodon* and this seems the best arrangement since it is fairly similar to, though relatively larger than, the European members of *C. leucodon*. It is quite similar to specimens of *C. lasiura* (D^2 value of 3.03) but the considerable discontinuity of distribution and Vinogradov's findings discourage the view that they might belong to the same species.

Specimens from Iran, including the holotype of *C. russula caspica*, are most similar to *C. leucodon lasia* from Turkey and other members of the *leucodon* group. In 1951 Ellerman & Morrison-Scott noted that *caspica* might represent *C. lasiura* (in which species they had placed *C. leucodon lasia*). However, Bobrinskii (1965), Lay (1967) and Richter (1970) placed it with *C. russula* in the *gueldenstaedti* subspecies group with a number of other subspecies which in this report belong to the Asian subgroup of *C. russula* and are readily distinguished from Iran specimens. Finally, Gureev (1971) included *C. r. caspica*, together with *C. r. monacha*, in synonymy with *C. gueldenstaedti*. This last seems very suspect since specimens of *C. r. monacha* from Turkey may be distinguished from Iran specimens on many characters (see Table 7). Despite the marked colour difference I believe these specimens from Iran should be regarded as a subspecies of *C. leucodon* – *C. leucodon caspica* – close to *C. leucodon lasia*.

Another subspecies, *C. leucodon persica*, also occurs in Iran. The holotype and one other specimen are in the BMNH. They resemble European members of *leucodon* in size and colour and are easily distinguished from Iran specimens of *C. l. caspica*. However, while all specimens seen of *C. l. caspica* are from low altitudes (the type series from under 25 m), *C. l. persica* appears to be a high altitude subspecies since the holotype was collected at 1980 m.

The resemblance of specimens from Israel and Lebanon to *C. russula* from Central Europe was noted by Thomas (1919) in his original description of *C. russula judaica*. In 1951 Ellerman & Morrison-Scott suggested the possible inclusion of this form with *C. lasiura* (along with *lasia*). Harrison (1963) considered it to be a local form of *C. leucodon* and this view is supported by the resemblance to specimens of *C. leucodon* from Turkey and Iran (see Table 7).

TABLE 7

Comparison of western Asian populations of *C. leucodon* with Asian and the most similar European populations of *C. russula*

	<i>C. russula</i> western Asia including <i>C. r.</i> <i>monacha</i> (Turkey)	<i>C. l. lasia</i> Turkey	<i>C. l. caspica</i> Iran	<i>C. l. judaica</i> Israel and Lebanon	<i>C. russula</i> Belgium, Germany, France Switzerland
Condylobasal length	17.5-19.5 \bar{x} 18.39	19.0-21.4 \bar{x} 19.99	19.4-20.4 \bar{x} 20.10	19.2-21.1 \bar{x} 20.07	17.7-20.1 \bar{x} 18.98
Upper toothrow length	7.6-8.8 \bar{x} 8.28	8.9-10.2 \bar{x} 9.29	8.8-9.4 \bar{x} 9.10	8.8-9.8 \bar{x} 9.26	8.1-9.1 \bar{x} 8.68
Width across maxillae at M ²	5.2-6.0 \bar{x} 5.65	6.2-6.8 \bar{x} 6.44	6.0-6.3 \bar{x} 6.17	5.8-6.8 \bar{x} 6.21	5.7-6.5 \bar{x} 6.01
Braincase breadth	8.4-9.4 \bar{x} 8.91	9.1-10.2 \bar{x} 9.53	9.2-9.8 \bar{x} 9.50	8.8-9.6 \bar{x} 9.13	8.5-9.5 \bar{x} 9.05
Ratio of tail to upper toothrow length	4.5-6.3 : 1 \bar{x} 5.48 : 1	3.7-4.9 : 1 \bar{x} 4.33 : 1	3.8-5.2 : 1 \bar{x} 4.7 : 1	3.6-4.5 : 1 \bar{x} 4.14 : 1	3.4-5.3 : 1 \bar{x} 4.43 : 1

The following subspecies have been examined and fall into two main groups :

C. l. leucodon (Hermann, 1780). Most of Europe (5, 11, 20).

C. l. persica Thomas, 1907. Elburz Mountains, Iran.

The second subgroup includes :

C. l. lasia Thomas, 1906. Turkey, Transcaucasia (23).

C. l. judaica Thomas, 1919. Israel and Lebanon (26).

C. l. caspica Thomas, 1907. S. coast of Caspian Sea, Northern Iran (27).

A sample from Switzerland (14) of uncertain affinity.

Keys 1 and 2 give the characters that are useful in distinguishing *C. leucodon* from other species occurring in the area. Despite the original naming of Iranian specimens as *C. russula*, they are particularly similar to specimens of *C. leucodon lasia* from Turkey mentioned above and can be readily distinguished from the Asian subgroup of *C. russula* by their more robust, longer and broader skulls. They are rather similar to the European subgroup of *C. russula*, but the skulls are on average slightly larger and the resemblance is unlikely to be a true indication of relationship. Table 5 gives a comparison of these populations.

Swiss specimens of *C. leucodon* are most closely associated in the analysis with Swiss specimens of *C. russula* at a very low D^2 value of 1.64 and with other European members of that species at D^2 values of 2-3. In Switzerland individual specimens of the two species are not readily distinguished from each other except on the basis of colour. Specimens of *leucodon* fall in the upper part of the *russula* size range (CBL 18.0-19.9 mm, \bar{x} 19.01 mm ; BB 8.5-9.4 mm, \bar{x} 9.13 mm in *russula* ; CBL 19.2-19.8 mm, \bar{x} 19.5 mm ; BB 9.2-9.5 mm, \bar{x} 9.38 mm in *leucodon*). This problem in Switzerland obviously requires very careful investigation into ecology, behaviour and genetics to try to establish the true relationship between these species.

Crocidura lasiura Dobson, 1890

The distribution of this species, represented in this report by the Korean population (46), is given in Fig. 14.

Korea is geographically isolated from Middle Asian populations of *C. leucodon*, yet the D^2 value between Korea and Turkey (23) is comparatively low, at 3.03. The range in skull size is similar for Korean and Turkish populations but on average Korean specimens have larger skulls, see Table 6. In Korean specimens the ventral pelage colour is only slightly paler than the dark dorsum, in contrast to the more marked differentiation in Turkish specimens.

In this study *C. lasiura* was represented by a large series from Korea, including the holotype of *C. l. thomasi*. In the CVA this sample showed some affinity to *C. leucodon lasia* (23) with a D^2 value of 3.03, but diverged more from *C. leucodon caspica* (27), a D^2 value of 4.77, and *C. leucodon judaica* (26) a D^2 value of 6.38. Ellerman & Morrison-Scott (1966) also noted this similarity but the evidence of dissimilarity in penis structure (Vinogradov, 1958) strongly suggests that it should be retained as a distinct species.

The subspecies examined was :

C. lasiura thomasi Sowerby, 1917. Korea (46).

See Key (p. 282) for comparison with other species in the surrounding area.

OTHER SPECIES RECORDED FROM THE AREAS OF STUDY BUT NOT INCLUDED IN THE ANALYSIS

The following species recorded from Eurasia are either absent from the collection or there are too few specimens for inclusion in the previous account.

C. hispida Thomas, 1913. Middle Andaman Island, Bay of Bengal. The BMNH houses the holotype, which is a very large animal, (CBL 27.4 mm) much larger than any of the species described in this account and with the tail longer than the head and body. It is also distinguished by its semi-spinous pelage.

C. andamanensis Miller, 1902. South Andaman Island, Bay of Bengal. No specimens apart from a small hair sample which differs from other species in that some of the hairs are flattened, although they are not so broad as the hairs of *C. hispida*, and there is no mention in the original description of the pelage being spinous. From the description of the holotype it appears to be comparable in size, though slightly smaller than *C. hispida* (CBL 25.6 mm).

C. nicobarica Miller, 1902. Great Nicobar Island, Bay of Bengal. No specimens apart from a small hair sample which contains flattened, broadened, hairs resembling those of *C. hispida* but less spinous. The condylobasal length of the holotype given in the original description is 27.0 mm.

C. miya Phillips, 1929. Sri Lanka. The skin and skull of the holotype are in the collection of the BMNH. The specimen is distinguished by the proportionately very long tail but in other respects it is very similar to *C. attenuata* (CBL 19.7 mm, UTL 8.7 mm, MB 5.9 mm, HB 79 mm, TL 88 mm).

C. caudata Miller, 1901a. Palermo, Sicily. No specimens examined. Kahmann & Einlechner (1959) believe that this is a subspecies of *C. russula*.

C. balearica Miller, 1907. Minorca, Balearic Islands. Kahmann & Vesmanis (1974) consider this to be a subspecies of *C. suaveolens*.

From the U.S.S.R. Gureev (1971) records the following species which I have not seen :

C. ognevi Stroganov, 1956. Altai.

C. pamirensis Ognev, 1928. Lake Drum vicinity, southern slopes of Pamir Mountain Range.

C. armenica Gureev, 1963. 14 km down river from Garni, Armenia.

C. dinniki Ognev, 1921. Stavropol'.

From Japan Imaizumi (1970) records :

C. orii Kuroda, 1924. Amami-Oshima, Riukiu Islands.

Preliminary examination of examples of the following forms recorded from Sumatra and Java by Chasen suggests that they represent *C. fuliginosa* :

C. villosa Robinson & Kloss, 1918. Sumatra. Holotype in BMNH.

- C. brunnea* Jentink, 1888. Sumatra, Java. Holotype of *C. b. brunnea* and ten specimens of *C. b. pudjonica* loaned by Leiden Museum.
- C. brevicauda* Jentink, 1890. Java. Holotype and fifteen specimens loaned by Leiden Museum.
- C. orientalis* Jentink, 1890. Java. Holotype and eight specimens loaned by Leiden Museum.
- C. melanorhyncha* Jentink, 1910. Java. Holotype and one other specimen loaned by Leiden Museum.

The following species recorded from the Malaysian region have also been subject to a preliminary examination and may be easily separated from *C. fuliginosa* by their small size (CBL 15.2–19.5 mm).

- C. monticola* Peters, 1870. Java, Borneo, Lombok, Sumbawa, Komodo, Flores, Sumba and ? Timor. There is only one specimen in the BMNH collections.
- C. aequicauda* Robinson & Kloss, 1918. Sumatra, Malay Peninsula. Holotype in BMNH.
- C. beccarii* Dobson, 1886. Sumatra. One damaged specimen only.
- C. bartelsii* Jentink, 1910. Java. Four specimens loaned by Leiden Museum.
- C. maxi* Sody, 1936. Java. One damaged specimen loaned by Leiden Museum.
- C. minuta* Otten, 1917. Java. Two badly damaged specimens loaned by Leiden Museum.

Of these *bartelsii* is probably conspecific with *monticola*. It is possible that *maxi* and *minuta* might also belong to this species, although more specimens are required to furnish any definite conclusions.

I have seen none of the remaining species listed by Chasen :

- C. paradoxura* Dobson, 1886. Sumatra.
- C. neglecta* Jentink, 1888. Sumatra.
- C. weberi* Jentink, 1890. Sumatra.
- C. lepidura* Lyon, 1908. Sumatra.
- C. vosmaeri* Jentink, 1888. Banka Island.

There are several unidentified specimens from Sulawesi which fall within the range of *C. fuliginosa* although this species has not previously been described from there. Laurie & Hill (1954) list the following species, none of which has been examined :

- C. elongata* Miller & Hollister, 1921. North eastern Sulawesi.
- C. nigripes* Miller & Hollister, 1921. North eastern Sulawesi.
- C. rhoditis* Miller & Hollister, 1921. North eastern Sulawesi.
- C. lea* Miller & Hollister, 1921. North eastern Sulawesi.
- C. levicula* Miller & Hollister, 1921. Middle Sulawesi.
- C. tenuis* (Müller, 1839). Timor.

Taylor (1934) records eight species from the Philippines of which the BMNH houses examples of only the first one :

- C. grayi* Dobson, 1890. Luzon and Benguet, Philippines. Holotype and two other specimens in the BMNH (CBL 18.6–20.0 mm, UTL 8.5–9.1 mm, BB 9.3–9.5 mm,

TABLE 8

Mahalanobis' distances. The 47 OTUs are numbered as in Table 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0.0															
2	3.1	0.0														
3	4.9	6.4	0.0													
4	6.2	7.9	2.0	0.0												
5	6.2	7.6	4.8	4.4	0.0											
6	4.5	6.4	1.9	2.0	4.8	0.0										
7	4.4	6.4	2.0	2.5	5.5	1.2	0.0									
8	5.8	8.1	3.7	2.5	4.7	2.4	2.8	0.0								
9	3.6	5.3	6.3	7.1	6.1	5.9	5.9	6.3	0.0							
10	6.6	8.4	2.6	1.4	4.5	2.9	3.1	2.9	7.5	0.0						
11	5.5	6.9	4.9	5.2	2.8	5.2	5.3	5.4	5.3	4.9	0.0					
12	2.7	3.1	6.5	7.8	8.1	6.1	5.7	7.4	4.0	8.3	6.9	0.0				
13	6.0	7.5	2.7	2.0	3.5	2.6	3.3	3.0	6.8	1.8	4.3	7.6	0.0			
14	6.9	8.5	4.0	3.2	3.4	4.1	4.7	3.9	7.5	2.4	4.2	8.7	1.6	0.0		
15	4.6	6.5	2.7	3.0	4.7	2.0	2.6	3.3	5.6	3.3	4.9	6.2	2.7	3.8	0.0	
16	7.2	9.2	3.5	2.1	6.0	3.1	2.9	2.8	8.1	2.2	6.4	8.5	3.4	4.4	4.0	0.0
17	3.1	4.2	3.4	4.5	5.7	2.9	3.2	4.7	5.7	5.2	5.9	4.9	4.5	5.8	3.9	5.7
18	3.2	4.1	6.4	7.4	7.4	5.8	5.4	6.9	3.4	7.9	6.4	2.2	7.3	8.4	5.7	8.1
19	2.0	3.4	5.3	6.7	7.2	5.0	4.6	6.5	3.9	7.2	6.2	2.0	6.8	7.9	5.2	7.5
20	5.6	7.5	4.2	3.6	1.9	3.8	4.5	3.5	6.2	3.6	3.3	7.7	2.9	3.0	3.9	5.0
21	3.1	3.9	4.5	5.6	6.5	3.8	3.8	5.6	4.5	6.2	6.0	3.5	5.5	6.8	3.6	6.4
22	4.7	5.5	3.5	4.1	6.1	2.8	3.4	4.5	6.9	4.8	6.7	6.1	4.0	5.3	3.7	5.2
23	8.0	9.3	5.3	4.4	3.4	5.3	6.2	4.9	8.6	4.0	5.3	9.9	3.1	2.3	5.4	5.8
24	3.7	4.4	3.3	4.5	6.3	3.1	3.3	5.0	6.2	5.4	6.5	5.0	4.8	6.2	4.3	5.7
25	3.3	4.6	4.0	5.0	6.7	3.2	3.1	4.8	5.9	5.7	6.7	4.4	5.3	6.7	4.5	5.7
26	9.3	11.2	5.9	4.1	5.6	5.7	6.0	4.2	9.7	3.8	6.8	10.9	4.4	4.3	6.5	4.0
27	7.4	8.5	4.7	3.7	4.0	4.4	5.1	4.2	8.1	3.7	5.6	9.0	2.5	2.8	4.6	4.8
28	2.6	3.6	3.6	4.7	4.6	3.3	3.6	4.8	4.6	5.1	4.3	4.2	4.1	5.1	3.7	6.0
29	3.7	2.9	6.9	8.2	8.6	6.4	6.4	8.0	6.4	8.9	8.4	3.8	8.1	9.3	7.2	9.1
30	2.7	4.0	6.1	7.0	5.9	5.5	5.5	6.2	3.4	7.1	4.8	3.3	6.2	6.9	5.3	7.9
31	4.7	5.9	3.9	4.1	4.9	3.3	3.7	4.1	6.7	4.7	5.7	6.5	3.9	5.1	4.7	5.3
32	3.5	3.8	4.1	5.2	6.0	3.7	3.9	5.3	5.9	5.7	6.0	4.5	4.8	6.1	4.5	6.3
33	6.0	5.3	8.7	10.2	11.5	8.5	8.2	10.2	8.2	11.0	11.0	5.2	10.6	12.0	9.2	10.9
34	8.2	7.9	8.2	8.6	10.0	7.6	8.0	8.8	10.6	9.5	11.2	9.2	8.7	10.0	8.7	9.5
35	5.9	5.6	6.6	7.4	9.0	6.0	6.3	7.6	8.3	8.4	9.6	6.6	7.6	9.0	7.0	8.4
36	8.0	7.7	6.6	7.0	8.9	6.4	6.9	7.9	10.4	7.9	10.0	9.2	7.2	8.5	7.5	8.1
37	10.8	10.7	9.5	9.8	11.7	9.6	9.9	10.5	12.9	10.5	12.8	11.9	10.3	11.2	10.8	10.7
38	10.9	11.7	8.4	7.7	8.6	8.3	9.1	8.5	12.9	7.7	10.2	12.9	7.5	7.5	9.1	8.6
39	13.1	13.6	10.4	9.7	10.2	10.6	11.4	10.8	14.9	9.7	11.9	15.2	9.5	9.3	11.2	10.7
40	10.0	9.2	10.0	10.7	12.6	9.7	9.9	11.1	12.3	11.7	13.5	10.4	11.0	12.4	10.8	11.5
41	11.7	11.8	9.3	8.9	9.4	9.5	10.3	10.0	13.3	9.3	11.2	13.5	8.7	8.9	10.3	10.3
42	2.4	3.7	3.9	5.2	6.0	3.7	3.2	5.2	4.2	5.7	5.1	2.9	5.2	6.4	4.3	6.0
43	12.1	12.0	9.8	9.5	9.8	10.1	10.8	10.7	13.8	9.8	11.5	13.8	9.1	9.2	10.7	10.8
44	6.4	6.9	5.3	5.5	7.1	4.8	5.5	6.0	8.7	6.5	8.4	8.1	5.7	6.9	6.0	6.8
45	3.3	3.3	7.5	8.8	9.1	6.9	6.8	8.3	4.7	9.4	8.2	2.0	8.7	9.7	7.0	9.6
46	9.8	11.0	7.9	7.0	5.4	7.7	8.6	7.2	10.5	6.5	7.1	11.9	5.7	4.7	7.6	8.2
47	3.3	2.7	5.1	6.5	7.3	4.8	5.1	6.8	5.7	7.2	7.2	4.0	6.2	7.5	4.9	7.8

TABLE 8 (Cont.)

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
17	0.0															
18	5.1	0.0														
19	4.0	2.0	0.0													
20	4.8	7.1	6.7	0.0												
21	3.3	2.9	2.7	6.0	0.0											
22	2.0	6.4	5.5	5.3	4.1	0.0										
23	6.5	9.6	9.2	3.3	8.0	6.0	0.0									
24	1.3	5.5	4.3	5.7	3.6	2.0	6.9	0.0								
25	1.5	4.7	3.7	5.8	3.4	2.7	7.6	1.7	0.0							
26	7.7	10.4	10.0	5.0	9.1	7.2	4.4	7.9	8.1	0.0						
27	5.5	8.6	8.4	3.8	6.8	4.6	2.4	5.8	6.3	4.2	0.0					
28	2.1	4.3	3.6	4.1	3.0	3.3	6.0	2.8	3.0	7.7	5.2	0.0				
29	3.8	4.8	4.0	8.1	4.6	5.2	9.9	4.0	3.5	11.2	8.9	4.4	0.0			
30	4.6	3.0	3.4	5.5	3.8	5.8	7.9	5.4	4.9	9.4	7.3	3.0	5.0	0.0		
31	2.3	6.5	5.7	4.0	5.2	2.9	5.2	2.9	3.0	6.1	4.3	3.0	5.3	5.4	0.0	
32	1.4	4.9	4.2	5.4	3.4	2.3	6.7	1.8	2.1	8.1	5.5	1.9	3.5	4.3	2.6	0.0
33	6.5	6.4	5.4	10.9	6.5	7.5	12.8	6.1	5.8	13.6	11.7	7.4	3.8	7.9	8.3	6.5
34	5.7	9.6	8.8	9.3	7.9	5.3	9.7	5.6	5.7	10.7	8.3	7.4	6.1	9.5	5.9	5.7
35	3.9	7.2	6.4	8.4	5.5	3.9	9.3	3.5	3.7	10.3	7.9	5.6	3.9	7.5	5.1	3.9
36	5.1	9.5	8.6	8.3	7.3	4.4	8.3	4.8	5.5	9.4	6.9	6.7	6.7	9.3	5.2	5.2
37	8.4	12.5	11.4	11.1	10.7	7.9	10.8	7.9	8.5	11.2	10.0	10.0	9.2	12.4	8.2	8.7
38	8.4	12.8	11.9	7.8	10.7	7.7	6.3	8.7	9.2	7.4	6.6	9.2	11.1	11.6	7.1	8.8
39	10.6	15.0	14.2	9.7	12.9	10.0	7.8	10.9	11.6	9.2	8.5	11.4	13.4	13.7	9.4	11.0
40	7.9	11.1	10.3	12.1	9.5	7.4	12.3	7.3	7.7	13.1	10.8	9.6	7.4	11.6	8.6	7.8
41	9.0	13.5	12.7	9.1	11.4	8.4	7.4	9.1	10.0	9.1	7.5	10.0	11.3	12.5	8.0	9.3
42	2.9	3.1	2.2	5.5	2.7	4.2	7.7	3.0	2.7	8.3	6.7	2.2	4.1	3.4	4.1	2.8
43	9.5	13.9	13.1	9.7	11.8	8.8	7.9	9.6	10.5	9.7	7.9	10.3	11.7	12.8	8.5	9.6
44	3.5	8.2	7.3	6.3	6.2	3.0	6.7	3.6	4.1	7.9	5.5	5.2	5.9	7.7	3.4	4.0
45	5.3	3.0	2.9	8.6	4.1	6.5	10.8	5.6	4.9	12.1	9.9	5.1	3.4	4.1	7.1	5.2
46	8.4	11.6	11.2	5.2	10.1	8.0	3.0	9.1	9.6	6.4	4.8	7.9	11.6	9.4	7.1	8.6
47	2.8	4.6	3.8	6.8	2.8	3.5	8.3	2.9	3.3	10.1	7.2	3.2	3.2	4.7	4.9	2.7
33																
34	0.0															
35	7.8	0.0														
36	5.4	3.0	0.0													
37	8.5	2.7	3.6	0.0												
38	9.9	4.9	6.4	4.8	0.0											
39	13.6	7.7	9.3	6.4	8.4	0.0										
40	15.8	9.8	11.5	8.4	9.8	2.7	0.0									
41	7.6	3.7	4.2	4.7	4.7	10.4	12.2	0.0								
42																
43	13.6	7.2	9.1	5.9	7.1	3.7	3.7	9.2	0.0							
44	6.2	8.0	5.7	7.5	10.4	10.7	12.9	9.7	11.4	0.0						
45	14.0	7.9	9.6	6.4	7.6	4.3	4.0	9.6	1.5	11.7	0.0					
46	8.2	3.3	3.5	2.4	6.1	6.3	8.5	6.1	6.4	6.2	7.1	0.0				
47	4.5	8.8	6.2	9.2	11.8	13.3	15.5	9.9	13.7	4.3	14.1	8.1	0.0			
48	14.7	11.0	11.1	9.8	12.1	6.1	7.2	13.9	7.7	9.9	8.0	8.3	12.5	0.0		
49	5.3	6.3	3.8	5.9	9.2	10.2	12.3	7.7	10.4	3.7	10.7	5.1	3.9	10.1	0.0	

HB of holotype 68 mm, TL of holotype 51 mm). This species seems very similar to *C. attenuata*.

- C. parvacauda* Taylor, 1934. Cotabato, Philippines.
C. halconus Miller, 1911b. Mindoro, Philippines.
C. beatus Miller, 1911b. Mindanao, Philippines.
C. mindorus Miller, 1911b. Mindoro, Philippines.
C. grandis Miller, 1911b. Mindanao, Philippines.
C. palawanensis Taylor, 1934. Palawan, Philippines.
C. edwardsiana Trouessart, 1880. Jolo, Sulu Archipelago, Philippines.

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